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ALL INDIA VILLAGE INDUSTRIES ASSOCIATION

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RICE

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MODEL CENTRE FOR VILLAGE INDUSTRIES
T. KALLUPATTY
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S. No

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ERRATA

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4	3	requirment	requirement
,,	Foot-note	Chapter IV. (a) 6	Chapter IV. (1) 7
5	4	Rice treated	Rice in grammes per-cent treated
,,	17	cousuming	consuming
7	1	P_1	B_1
10	5	microgams	micrograms
,,	25	4 to 5 mic. g.%	4 to 5 milli.g.%
11	5	3 mic. g.	3 milli.g.
13	14	prduced	produced
,,	20	18%	1.8%
17	17	80 lbs.	30 lbs.
19	last line	chakki	chakki[3]
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29	Head line	cem	cement
31	26	Rs 15/-	Rs. 15/-[2]
32	9	$4\frac{1}{2}''$	$4\frac{1}{2}'$
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PUBLISHER'S NOTE

Our people are in a chronic state of weakness and malnutrition. If they are to be restored to full life and vigour, one of the first things that requires to be done is to see that within the means available to them they obtain wholesome, well-balanced food which will keep their bodies in a healthy and fit condition.

Owing to poverty on a scale almost unknown hitherto in this country or in other parts of the world, the inhabitants of our land are forced to live on one or two cereals, some salt and perhaps an onion or green chillies. The most important of such cereals is rice. It is the staple-food of millions of our people.

Crucial it is therefore to study the problems relating to rice, to see that all that the grain is capable of giving is fully availed of by the consumer, and what the grain cannot provide is supplemented in other ways.

Fortunately for us, the nutritive aspect of Rice has been studied scientifically by experts, more especially by the Nutrition Research Laboratories, Coonoor, and their findings have been published within the last year or two. In regard to the diet aspect of Rice, dealt with in Chapters I and IV and Appendices A and C of this pamphlet, we have drawn freely from their findings, our aim being merely to put into the hands of village workers scientific data furnished by experts in the field. Chapters II and III relate to our own researches in regard to instruments for husking paddy and the economics of the rice pounding industry.

As so little is known in regard to the nutritive value of articles consumed by the people, we have thought it well to give available information in the form of Appendices, and to direct the reader to a selected list of literature. Material which can be converted into posters suitable for carrying on propaganda amongst the people has also been added in the form of an Appendix.

This edition has been revised and a chapter on Parboiling has been added.

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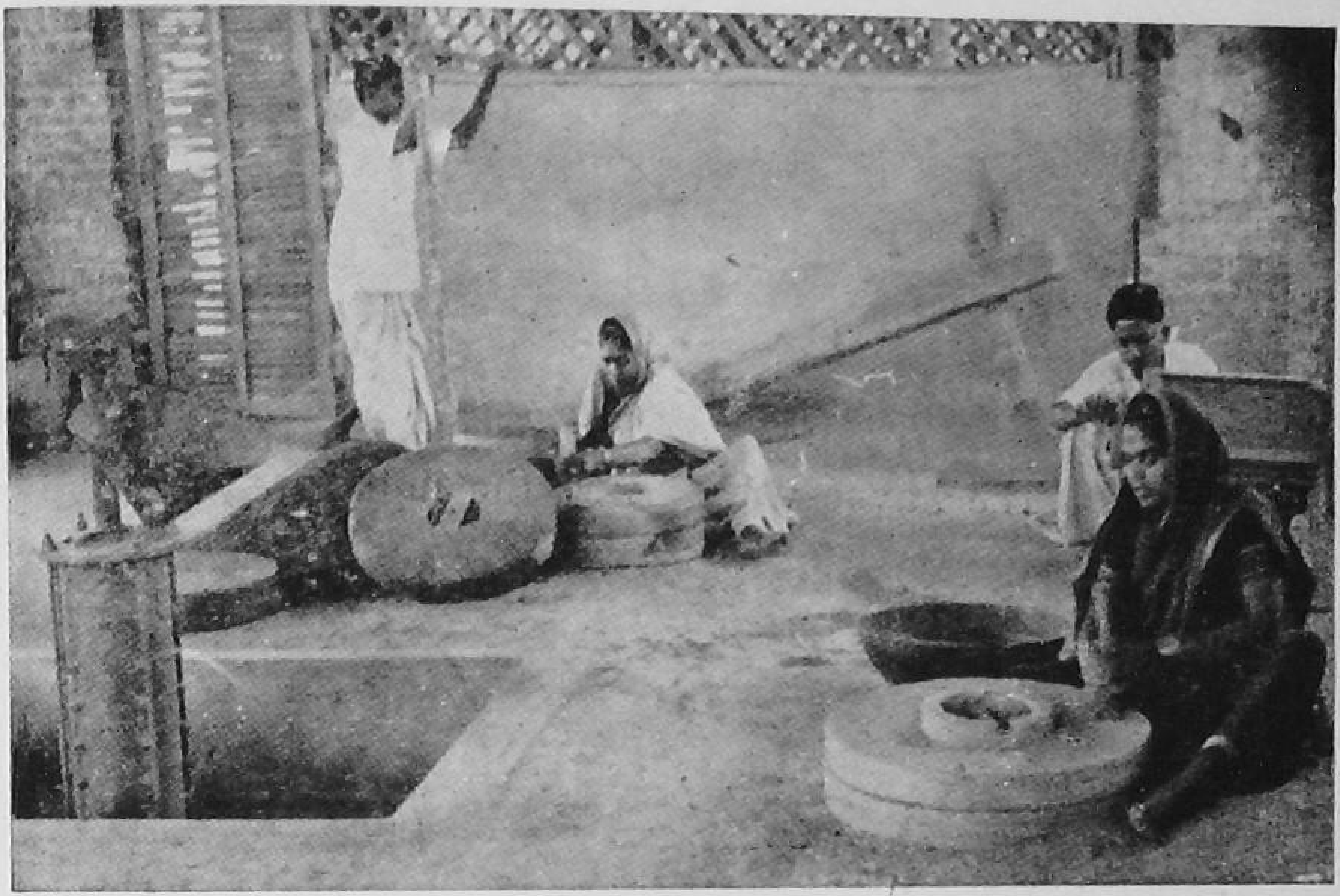
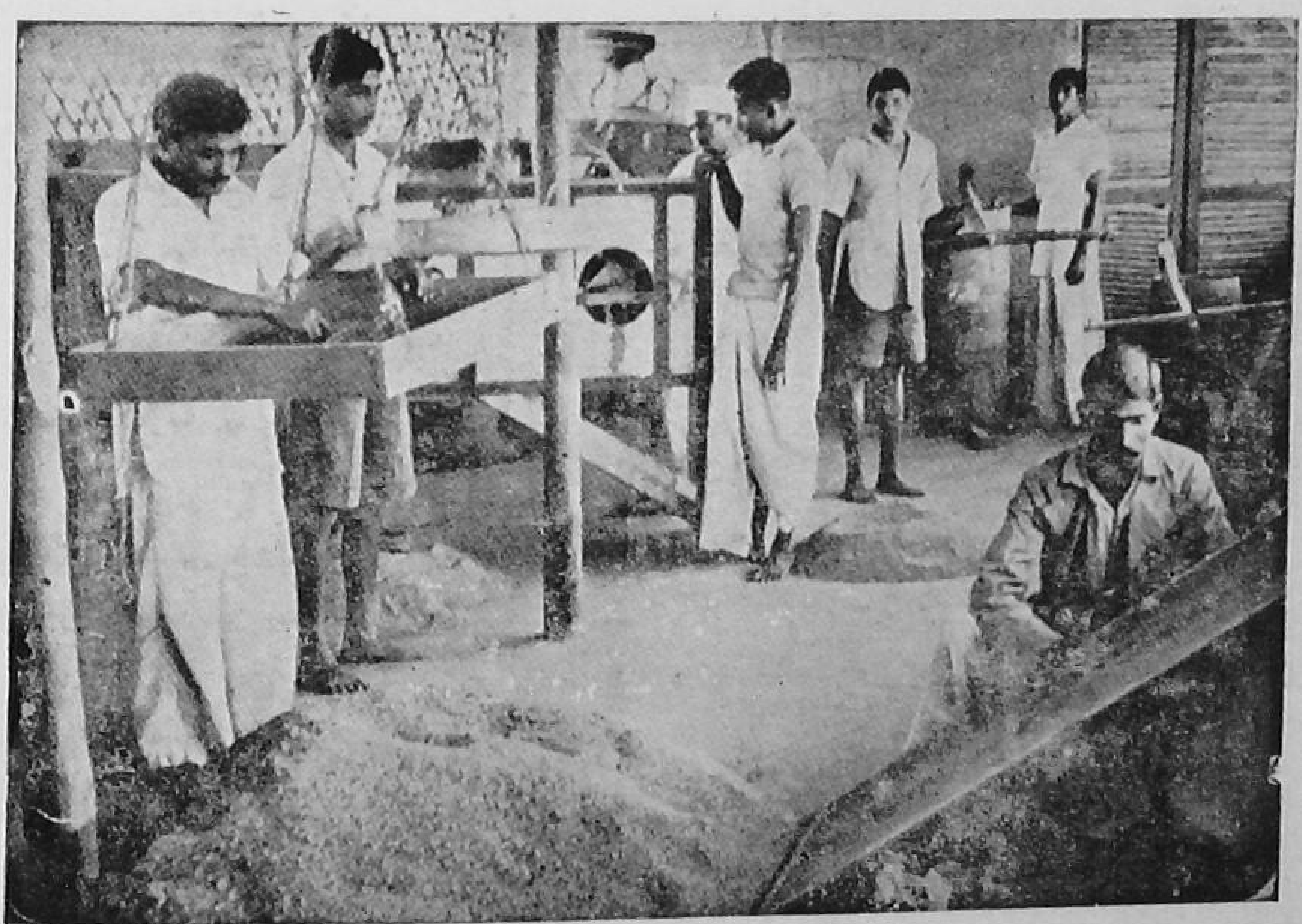
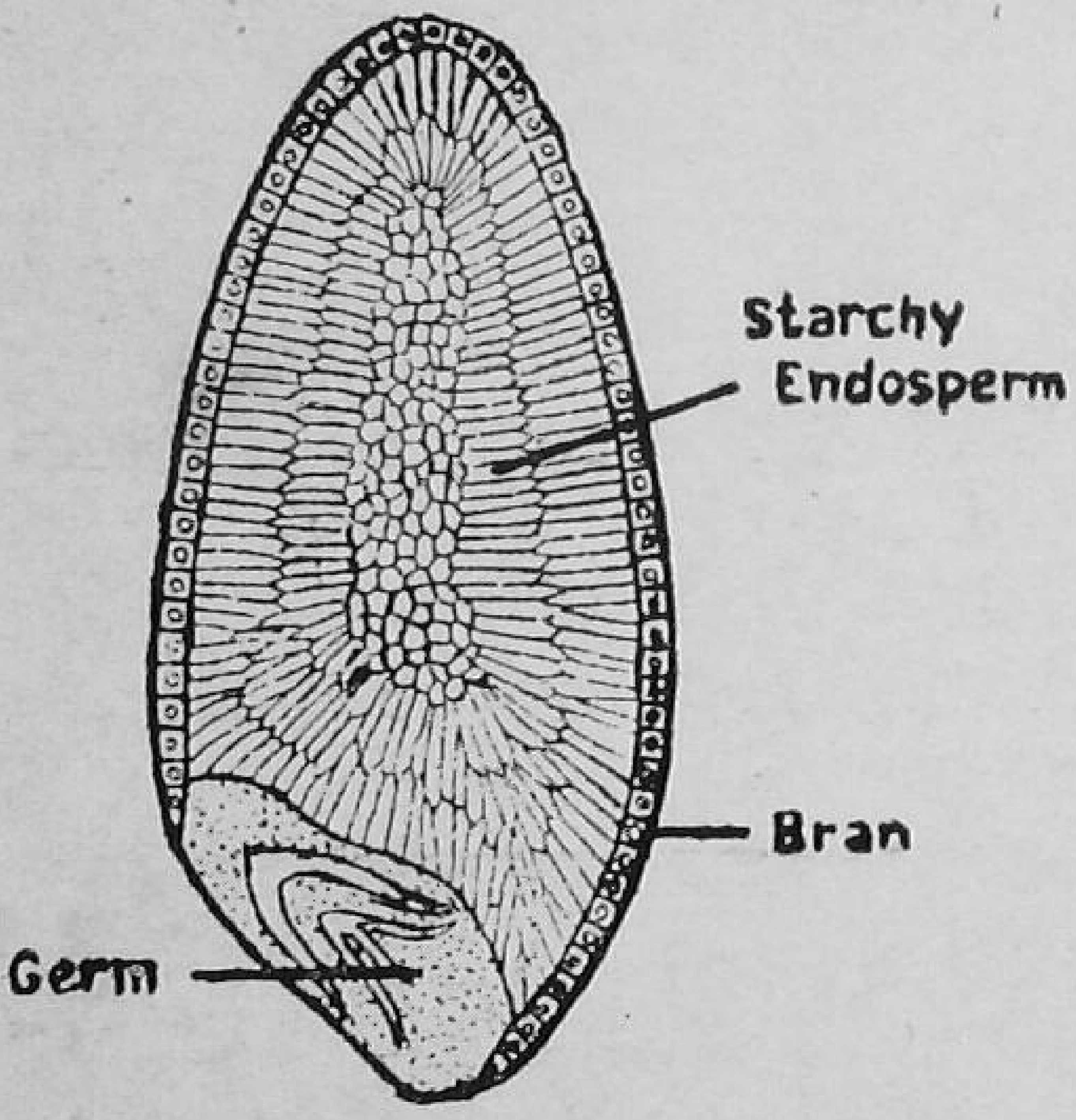




Paddy-Husking and Winnowing in Maganvadi

The havoc wrought by the mills.



Section of a unmilled grain

Germ and outer layers intact

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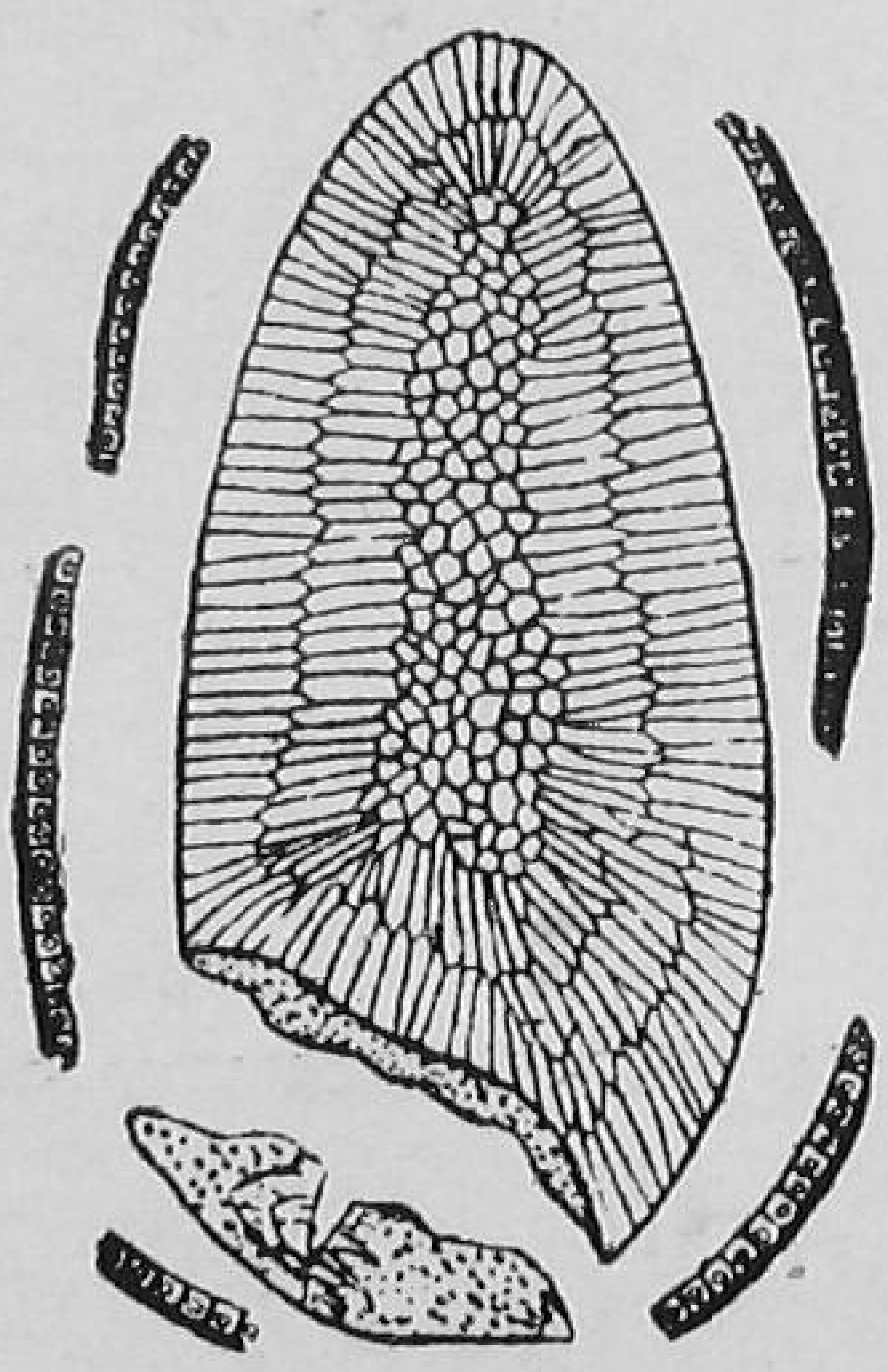


Section of a milled grain.

Germ and outer layers removed

(2)

RICE

CHAPTER I

THE FOOD VALUE OF RICE

Rice is one of the most important cereals in the world. About half the world's population live on it as their staple cereal. Japan, China, the Philippines, Netherlands, East Indies, Indo-China, Burma and India between them grow 90 % of the world's annual supply. In India, rice forms the staple food of over half the population. In 1935-36, 33 % of the total area sown with cereals, pulses and millets was rice. As a rule Indian diet is composed of the main cereal in a very large proportion and small quantities of other foods. From surveys carried out by or through the Nutrition Research Laboratories, Coonoor, of the diet of poor families in various parts of the country, it was found that rice supplied more than 80 % of the total calories of a person's daily food. The nutritive value of such diet, therefore, depends very largely on that of the main ingredient.

The rice grain is encased in a thin brown husk and consists of 3 parts, (1) the outer layer called the pericarp, (2) the germ, and (3) the major portion composed of starch and called the endosperm. (*See sketch opposite.*) The outer layers *i. e* the pericarp and germ are richer in various food elements than the endosperm. They constitute nearly a sixth of the whole grain, and contain more than half of the mineral matter of the grain, a fourth of the proteins and practically the whole of the vitamins and fat. The extent to which any

cereal can be deprived of these layers depends on its shape, size and other factors. The husk has to be removed before rice is fit for consumption, and the shape and consistency of the rice grain are such that in the dehusking process the valuable outer layers can be almost entirely removed by simple mechanical means.

The customary method in India of shelling rice is to pound it in a stone or wooden mortar with a wooden pestle, which splits the husk and allows it to be removed by winnowing. During the last few decades machines worked by electric or steam power are increasingly doing this work. Rices treated in both these ways have been scientifically tested and it has been found that machine milling entails a greater loss of the germ and pericarp. The amount of these removed, when pounding is done by hand, depends on the extent and duration of pounding. Typical hand-pounded rice, however, retains 50 to 75% of the pericarp, the germ usually being completely removed. But rice milled in machines loses most of its important food constituents, more so than other cereal products treated in the same way.

One process which is applied to rice and to no other cereal is parboiling *i. e.* to soak the unhusked rice in water and after draining steam or boil it. This splits the woody husk and renders its subsequent removal either by hand-pounding or milling easier. Rice so boiled can also be used immediately, whereas raw rice is not fit for consumption till some months after it has been garnered. Striking changes are brought about in the nutritive value of rice as a result of parboiling so that it does not lose as much of its constituents as raw rice does when milled in a machine. Briefly described, they are as follows: During the process of boiling some of the vitamins and other nutritive substances contained in the

germ and pericarp diffuse through the grain and cannot be removed by subsequent milling. Milled parboiled rice has thus a higher nutritive value than milled raw rice. As parboiled rice is or was consumed by the majority of people in Assam, Bengal, Bihar, Orissa and Madras excepting northern Andhra, these changes are of great practical importance. But although parboiling before milling reduces the loss, there is still a definite lowering of nutritive value in milling in a machine as compared with dehusking by hand-pounding. Less milled rather than highly milled rice, therefore, is desirable from this point of view. Such rice can be best produced by the indigenous method of pounding or grinding by hand.

1. FOOD CONTENTS OF RICE

The function of food is threefold: (1) to supply the substances that make the body grow and repair the tissues as they get worn with use: these are called proteins; (2) to provide the energy for the various functions of the body, the heart to beat, the lungs to breathe, the muscles to move, the stomach to act on the foods; this energy is supplied by fats and carbohydrates; (3) to maintain the human system in healthy working order; for this mineral salts and vitamins are required. Almost any kind of food can supply energy, but for growth and maintenance of a healthy condition of the body some foods are better than others. Most of the common foods have been scientifically analysed and their constituents recorded[1]. The quantities of each of the three above mentioned classes of foods necessary for the human system have also been found out by various tests. It is therefore possible to make up balanced diets which will satisfy all the requirements of the body. Rice contains, besides starch, protein, iron, calcium,

1 See Appendix C below the nutritive value of Indian articles of food.

phosphorus, fat and vitamins A and B. If it is pounded by hand the quantity of protein, phosphorus, and vitamin B_1 present in it is sufficient for the body's requirments. For an adequate supply of the other constituents, however, the rice eater must look to other articles of food[1]

Protein:—Protein is one of the most important food constituents as it is necessary for growth and repair of the tissues of the body. Whole rice, as compared with other cereals and most millets, has a low protein content. The mean protein content of Bengal and South Indian varieties is:—

Hand-pounded raw rice.........7.1	grammes	percent
" " parboiled.........7.2	"	"
Machine milled raw...............6.2	"	"
Machine milled parboiled........6.1	"	"

Wheat has much more protein value chemically but the biological value of rice proteins has been found to be high; so that there is not a protein deficiency in rice as compared with grains, with a higher protein content of lower biological value. Rice is the main source of protein in the poor rice eater's diet.

Phosphorus:—Phosphorus is necessary for all living tissues and is an important constituent of blood. Rice is poorer than most other cereals in it. Most of it is contained in the pericarp and so the quantity present is largely determined by the amount of pericarp present, and as the degree of milling proceeds the phosphorus content falls. In highly milled samples, where 20% of the polishings are removed, only 12 to 30% of the phosphorus originally present is left.

1 See chapter IV, (a) 6 "Supplementing the deficiencies of a Rice diet."

Parboiling does not much reduce the loss in milling, as is clear from the figures given below. Washing and cooking also remove much of it. The following is the phosphorus content of rice treated in various ways:—

Hand-pounded raw rice	... ...	0.28
,, ,, parboiled	... ...	0.26
Machine milled raw	... ...	0.13
,, ,, parboiled	... ...	0.14

Calcium:—Calcium is necessary for the growth of the bones and teeth. It makes the heart work properly, and the blood to clot so that too much does not go out if our bodies are cut or wounded and it helps our bodies to use properly other constituents of food such as fats and iron. Analysis of various rices shows that rice has a low calcium content and is a poor source of this element, whatever the variety or treatment. It has been calculated that a poor rice eater, cousuming 600 grammes of rice daily, obtains only .03 to .06 grms. of calcium from it. This is considerably below physiological requirements.

Iron:—Iron, being an essential part of the red pigment of the blood-haemoglobin, is needed for blood formation. It enables the blood to carry oxygen from the lungs to every part of the body. For lack of sufficient iron in the food, people suffer from general weakness, a sense of weariness, and anaemia. Mere sufficiency of iron in the food, however, is not enough; for vitamins A, B, C and E, as well as calcium and a substance produced by the liver, are necessary for the iron to be properly utilised by the body. Rice is poor in iron as compared with other cereals and most common foodstuffs, and milled rice is worse than handpounded.

Fat:—Like all cereals the fat content of rice is very small. But it is not known for certain how much fat human beings require and there is no evidence that a low consumption of fat produces ill effects. The fact that rice contains little fat does not, therefore, appear to detract from its value as an article of food.

Vitamin B1:—Vitamin B1 is needed for the building and repair of the body. 1 It keeps the brain, the nerves, the heart, the liver, the digestive glands and the kidneys healthy and strong. 2. It enables the muscles of the body, including those of the bowels, to remain in a fit condition' 3. It maintains the appetite and aids digestion. When food contains plenty of Vitamin B1 it is not only eaten with relish but digested well and waste materials are discarded properly from the body. If any vitamin can be said to be more important for health and well being than any other, it is Vitamin B1. Vitamin B1 is also necessary for the prevention of beri-beri This is a disease which attacks the nerves causing their degeneration and producing partial or complete paralysis and which also weakens the heart muscles and leads to heart failure. In a severe form it is often fatal, but when properly treated, can be cured.

Rice contains a good amount of this vitamin, which is abundantly present in the germ and pericarp of the grain, while the endosperm contains it in much smaller quantities. Faulty methods of preparation remove most of it, and the continuous use of such deficient rice causes the disease. The relation between the consumption of highly milled rice and beri-beri was established beyond doubt about 25 years ago. Experiments and observations among groups of people living on such rice, led to the conclusion that the disease was caused by the deficient intake of the anti-neuritic vitamin

B_1. It was also found that people who eat parboiled rice, usually escape beri-beri and that patients suffering from the disease improved when placed on this diet; and that it disappeared from groups who changed over from milled to parboiled rice. As the latter was usually hand-pounded it was assumed that the difference between the two was due to milling. Latter investigation showed that parboiled rice retained a considerable proportion of Vitamin B_1 even when highly milled.

Cereals, as a group, have a high Vitamin B_1 content. The supplementary foods, composing a typical diet, are not rich in it and are anyhow taken only in small quantities. While pulses are also rich in Vitamin B_1 they are not taken in large quantities. The main supply, therefore, being derived from the cereal, the Vitamin B_1 content of the latter becomes important. The following are the Vitamin B_1 contents of some of the staple foodstuffs:—

Wheat	5.3	micrograms	per gramme
Cholam	2.9	"	"
Ragi	3.0	"	"
Tapioca	0.6	"	"
Potato	0.8	"	"
Raw hand-pounded rice	2.3	"	"
" milled "	1.1	"	"
Parboiled hand-pounded rice	2.9	"	"

The Vitamin B_1 content of husked or unmilled rice is high. But the amount present in the product used for consumption, depends on the degree to which it has been milled and whether it has been parboiled or not. The Nutrition Research Laboratories, Coonoor, have experimented with 8 varieties of rice, husking each, both in the parboiled and in the raw state,

in a wooden grinder, a Japanese huller, the ordinary mill and by hand-pounding. The following are the figures arrived at by them :—

	Wooden Grinder	Japanese huller	Hand pounded	Machine milled	Hand pounded	Machine milled
	RAW				PARBOILED	
	In micrograms per gramme					
1	2.3	2.5	2.1	0.6	2.1	2.1
2	3.2	3.7	2.9	1.3	2.4	2.0
3	3.3	2.7	1.5	1.0	2.7	2.6
4	2.6	2.9	2.1	1.3	2.4	1.6
5	3.2	2.9	2.1	1.3	2.0	1.7
6 (a)			3.9	1.2	...	2.9
6 (b)			2.5	0.8	2.7	1.9
7			2.3	0.9	2.5	2.1
8			2.4	0.9	2.4	2.6
Average		2.9	2.4	1.0	2.4	2.2

The wooden grinder and Japanese huller gave products rich in Vitamin B_1. The values of parboiled rice treated in these were practically similar to the figures given above for raw rice. The water in which the paddy was before boiling soaked for 48 hours with one change, showed no traces of Vitamin B_1, while quantities less than 5% of the amounts originally present, were found in the water in which the paddy was boiled.

Though pounding removes some Vitamin B_1 hand-pounded rice remains a fairly rich source of it. Parboiled hand-pounded rice retains more of it than raw hand-pounded.

In the experiment described above both raw and parboiled samples were milled in machines to the degree which is usual with the ordinary rice sold in the bazars. It was

found that raw rice lost 2/3 of the Vitamin B1 originally present while parboiled lost only 1/3. Parboiled rice retains a considerable proportion of Vitamin B1 even when highly milled. The explanation must be that during the process of steaming, some of the Vitamin B1 contained in the germ and pericarp enters into the grain as already pointed out and cannot be removed by subsequent milling. Raw and parboiled rices were tested for Vitamin B1 at various stages of milling and when the degree of milling was 17 to 22 % the content in raw rice was below 1 mic. g. while that in parboiled was between 2 and 3 mic.g. This was proved again, when the milling of raw and parboiled rice were tested at different stages of husking. The following table gives the Vitamin B1 contained in the bran of each after being milled for various periods :—

Duration of milling	Bran from raw rice	Bran from parboiled rices
0.—5 Minutes	45 micro g per gramme	25 mic. g. per gramme
5-10 ,,	55 ,, ,,	16 ,, ,,
10.-15 ,,	23 ,, ,,	15 ,, ,,
15-20 ,,	11 ,, ,,	11 ,, ,,

The 4 figures represent layers of the grain. Since the endosperm of parboiled rice has gained Vitamin B1 at the expense of the germ and pericarp, its bran is poorer in the vitamin than the bran of raw rice. In the latter the outer layers are seen to be much richer than the inner, while with parboiled rice the figure for the outermost layer is not large, nor does it fall as much as in the other case. Parboiled rice is tougher than raw rice and the layers reached in the same period may not be identical in the two cases. But the table sufficiently illustrates that less Vitamin B1 is wasted in parboiled than raw rice during the necessary process of husking.

The loss of Vitamin B1 as the rice passes through the various stages in the modern mill is indicated by the following figures which represent the quantity of Vitamin B1 left at each stage.

In microgams per gramme	
Shelled	4.0
Once polished	1.8
Twice polished	1.0
Thrice polished	0.7

The last is the product sent out to the market and it is less by 80% than the original content.

The waste of a valuable constituent is also shown by the following figures, giving results of tests for Vitamin B1 in two samples of merely shelled rice, three varieties of parboiled milled rice, and three varieties of milled raw rice sold in the market.

Shelled	Parboiled milled	Raw milled
4.0	1.7	1.1
4.2	2.1	0.5
—	2.2	1.2

Nicotinic Acid or Vitamin B$_2$:—It has been recently found that this factor is essential for food and that it is an important member of the B$_2$ group of vitamins* The nicotinic acid content of husked rice, which retains its germ and pericarp almost intact, is 4 to 5 mic. g. %. By pounding, raw rice loses half the amount originally present, and by milling two thirds. This shows that most of the nicotinic acid is concentrated i- the germ and the pericarp. When parboiled, on the

* For information regarding the effects of various kinds of Vitamins on the body, and in what articles of food they are found, see Appendix D.

other hand, there is little loss on pounding or milling, showing that the nicotinic acid diffuses through the grain in the same way as Vitamin B_1. The losses incurred at various stages of milling were estimated and it was found that even when 20% of millings were removed, parboiled rice contained 3 mic.g. of nicotinic acid per cent. The degree of loss at each stage was also found to be strikingly similar to that of Vitamin B_1.

Vitamin A*:—Rice in any shape or form contains very little of this, and the rice eater's requirements must come from other foods.

Vitamin C*:—There is none in rice but it would presumably develop it on germination.

2. WASHING AND COOKING

Losses of nutritive elements also occur in washing the rice before cooking. Most of them are little affected by the degree of heat used in cooking but many are soluble in water. Washing, therefore, becomes important. The extent of the loss depends on the quantity of water used and the number of times it is done; but it must be noted that it is the first washing that removes most of the food factors.

Loss also occurs through the water in which rice is cooked. This is prevented if the water is consumed, or if just a sufficient quantity is used as is necessary for cooking, so that none is left to strain off.

Washing and cooking may differ from house to house but an approximate estimate of the losses due to both has been found to be in the following proportion.

---

*For information regarding the effects of various kinds of vitamins on the body, and in what articles of food they are found, see Appendix D.

Protein	10 %
Iron	75 %
Calcium	50 %
Phosphorus	50 %
Fat	50 %
Calories	15 %

The protein is not seriously reduced and rice in any case contains so little fat that the loss under this head is not important. But much of the calcium, phosphorus and iron is unnecessarily lost.

Besides these there is also the loss of Vitamin B_1. This was proved by the following experiment. 7 oz. of rice were washed 3 times, each time in 11 oz. of water, the time taken over it being 5 minutes; it was then cooked in 50 oz. of water, and the water strained off after cooking, this quantity being 35 oz. Three varieties were tried each being hand-pounded and milled, both in the raw and parboiled state. The percentage of Vitamin B_1 found in the cooked rice was as follows:—

Samples	Hand-pounded	Milled	Hand-pounded	Milled
	RAW		PARBOILED	
1	25	25	35	50
2	33	15	60	45
3	40	35	45	40

The respective amounts of Vitamin B_1 in the water in which the rice was washed before cooking and the water in which it was cooked were also estimated and were found to be as given in the table below. The percentages are for those of sample 2. The figures in the 5th column are those for imported broken raw rice.

	Hand-pounded	Milled	Hand-pounded	Milled	Broken
	Raw		Parboiled		Raw
Wash water	33	55	10	40	60
Cooking water	33	30	30	15	10
Cooked rice	33	15	60	45	30

The table shows that all the Vitamin can be accounted for in the cooked product and the water, and that none is destroyed. Washing and cooking with superfluous water are, therefore, an unnecessary waste which can and should be prevented. There was some reason to think from these experiments that Vitamin B1 can be more readily washed out of raw rice than out of parboiled. Experiments by other workers and with other varieties of rice, confirm the fact that loss of Vitamin B1 prduced by washing and cooking is as great as that involved in milling and deserves equal attention. Another constituent of rice that is lost in washing and cooking is nicotinic acid This loss has been found to be about 40%. The nicotinic acid content of cooked rice is as follows:—

Raw milled cooked rice	0.4 to 0.6%
Parboiled milled rice	1.4 to 18%

The nicotinic acid content in most of the samples tested was 10 to 20 times that of the Vitamin B1 content.

It is possible that other food factors which may be concentrated in the outer layers of rice may also be soluble in water and behave in the same way as Vitamin B1 and other factors described above.

3. BY-PRODUCTS

The question of the by-products of rice also requires some consideration. As the husk must be removed before rice can be used for consumption some by-products result in

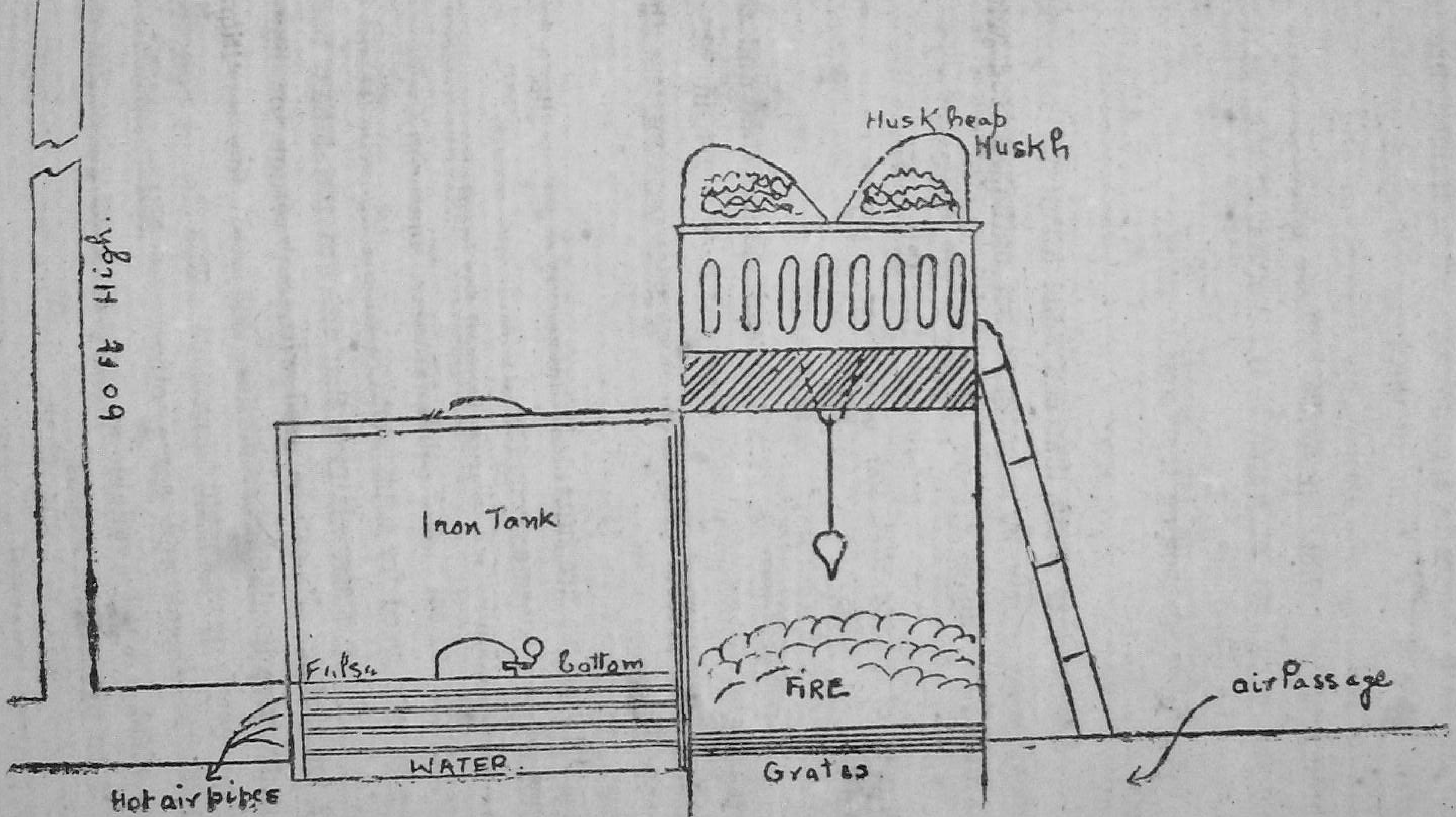
the process of doing so. Their nature and quantity depend on the method employed. In the ordinary small power mill which exists at present in largest number, the article removed from the grain is a mixture of husk and bran. It cannot be used as food by human beings nor for cattle, as sharp husk is indigestible. As fuel also it is poor in quality. When rice is pounded by hand or shelled in the larger mills the husk is separated from the bran. The former is used as fuel by blacksmiths and others or by the mill itself and the bran is sold as cattle food. On this account also hand-pounding is preferable to husking the paddy in small power driven mills.

Utilisation of Husk for Parboiling Paddy

Husk is generally considered a waste. We find heaps of it lying around any rice mill. People do not throw it in fields as it does not easily get mixed up with the earth. So the only use for husk is to use it as fuel. As a rule people were using husk together with fuel or coal in the boilers. Now and then the boiler attendant used to throw into the furnace a handful of husk. Immediately, the husk used to give out a big flame and within a short time it will all drop down through the grates, some unburnt and major portion of it being left a little charred. In these ovens, the husk does not get burnt completely till it results in white cinders. The new device is intended to utilise the husk fully and get the utmost advantage out of it.

A picture of the oven for the better burning of the husk is given on the next page The husk is stocked above the oven. One man sits there and goes on gradually dropping the husk through the slot in the middle. Just in the middle of the slot is suspended a plump ball made out of earth. The husk that falls from above is distributed in all directions

A Special type of oven for utilising Paddy husk exclusively used for Parboiling of Paddy.



by this ball. There is a continuous white flamed fire in the oven. Due to the action of the long chimney on the other side of the oven, the flame gets sucked up and it passess through 3 or 4 hot air pipes. These pipes, in turn, pass through a column of water in the bottom of the parboiling tank. The water gets heated and issues forth steam, which is utilised for parboiling the soaked paddy above the false bottom in the tank.

An ordinary tank that can hold about 20 maunds of paddy, takes nearly 30 minutes to get parboiled and within this time near about 2 bags of husk are burnt. 2 bags of the husk costs next to nothing, and if this can parboil 20 maunds of paddy then the parboiling charges have surely been brought down.

However, there is one disadvantage in this and that is the oven requires a chimney nearly 60 feet in height, which at the present price level may cost nothing less than Rs. 500 to 600.

Of late, we are informed that paddy husk, being a substance of low thermal conductivity and not easily susceptible to destruction by white ants, is used for insulating purposes in the place of cork and other similar materials. This is being largely used for cold storage rooms and the result is satisfactory. It is also claimed that this material has been used for roofing. It can be used with advantage for lining walls; to give insulating properties and also for partitions where a heavy load should be avoided. The binding material for husk is cement and some other chemicals, particulars about which are not available as the above manufactures are said to be patented processes.

CHAPTER II

INSTRUMENTS FOR HUSKING AND POLISHING RICE

There are a number of indigenous instruments used in different parts of India for the home pounding of rice.

1. Assam Wooden Chakki—the Delain

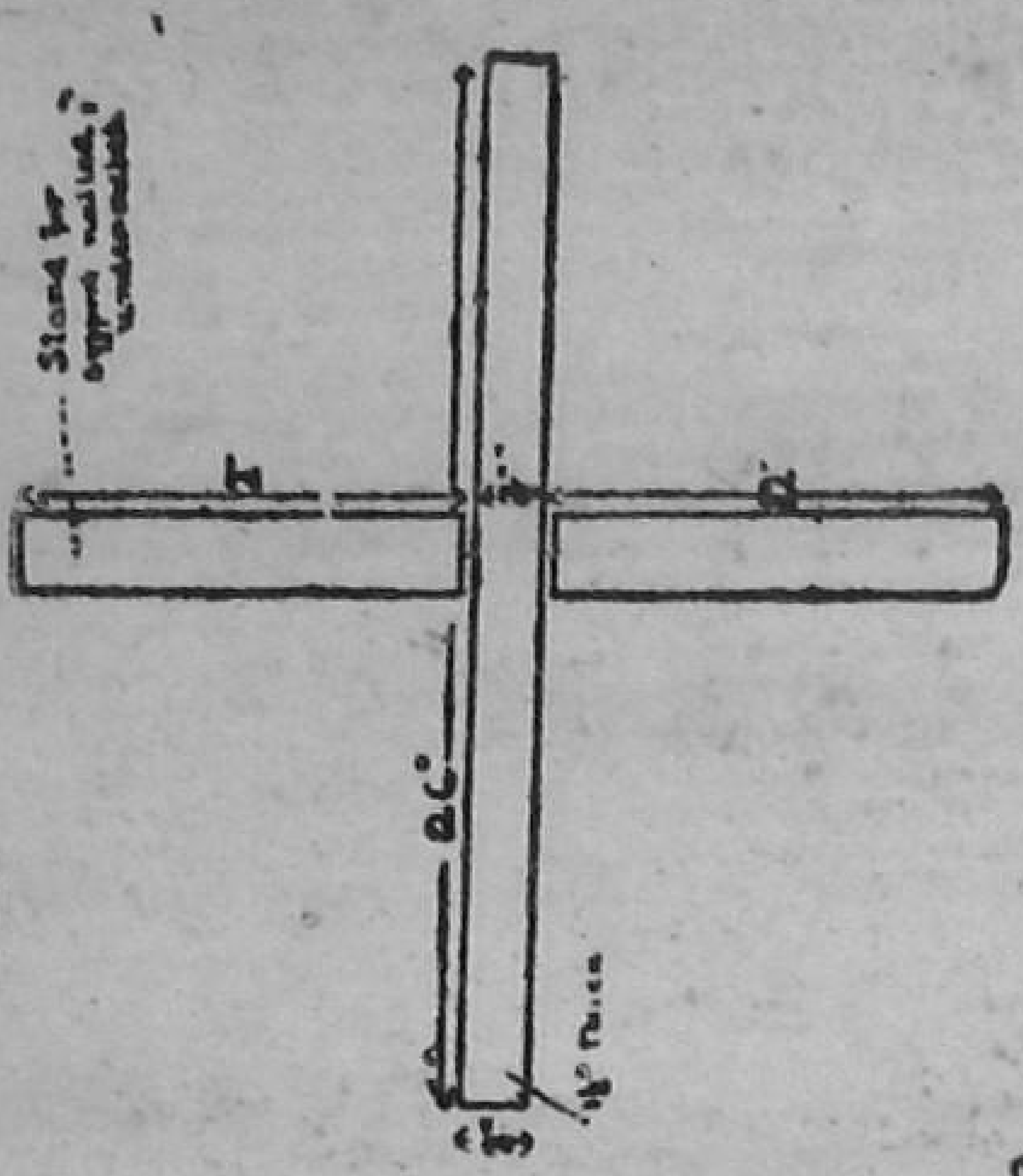
This consists of 2 cylindrical wooden grinders one resting on the other. It is 5 ft. in height and 15″ in diameter, and is worked by a 'T' shaped shaft which is pulled forwards and backwards by a man standing. It is claimed that this can husk about 100 lbs. of paddy in an hour. It costs about Rs. 9.

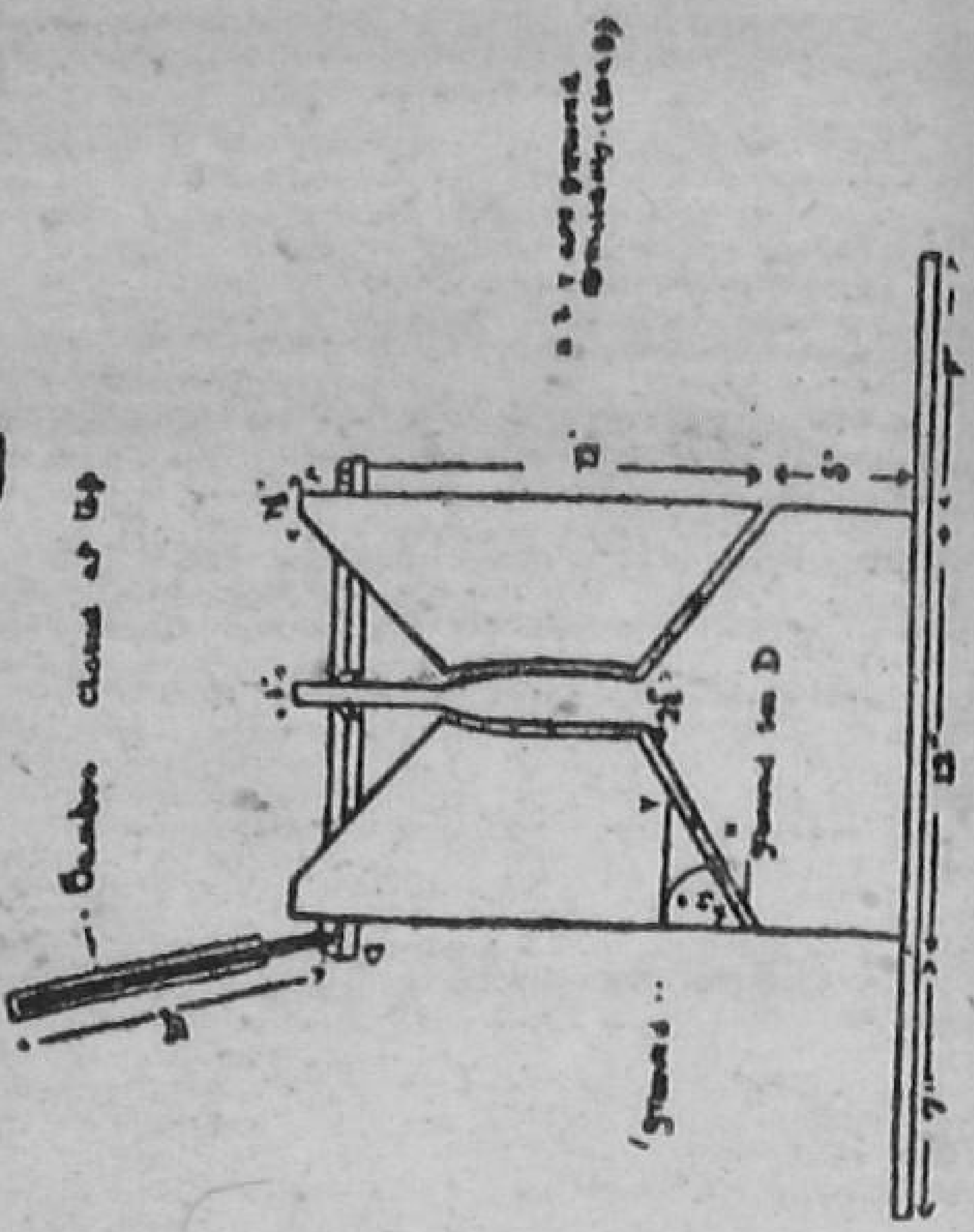
2. Bengal Wooden Chakki

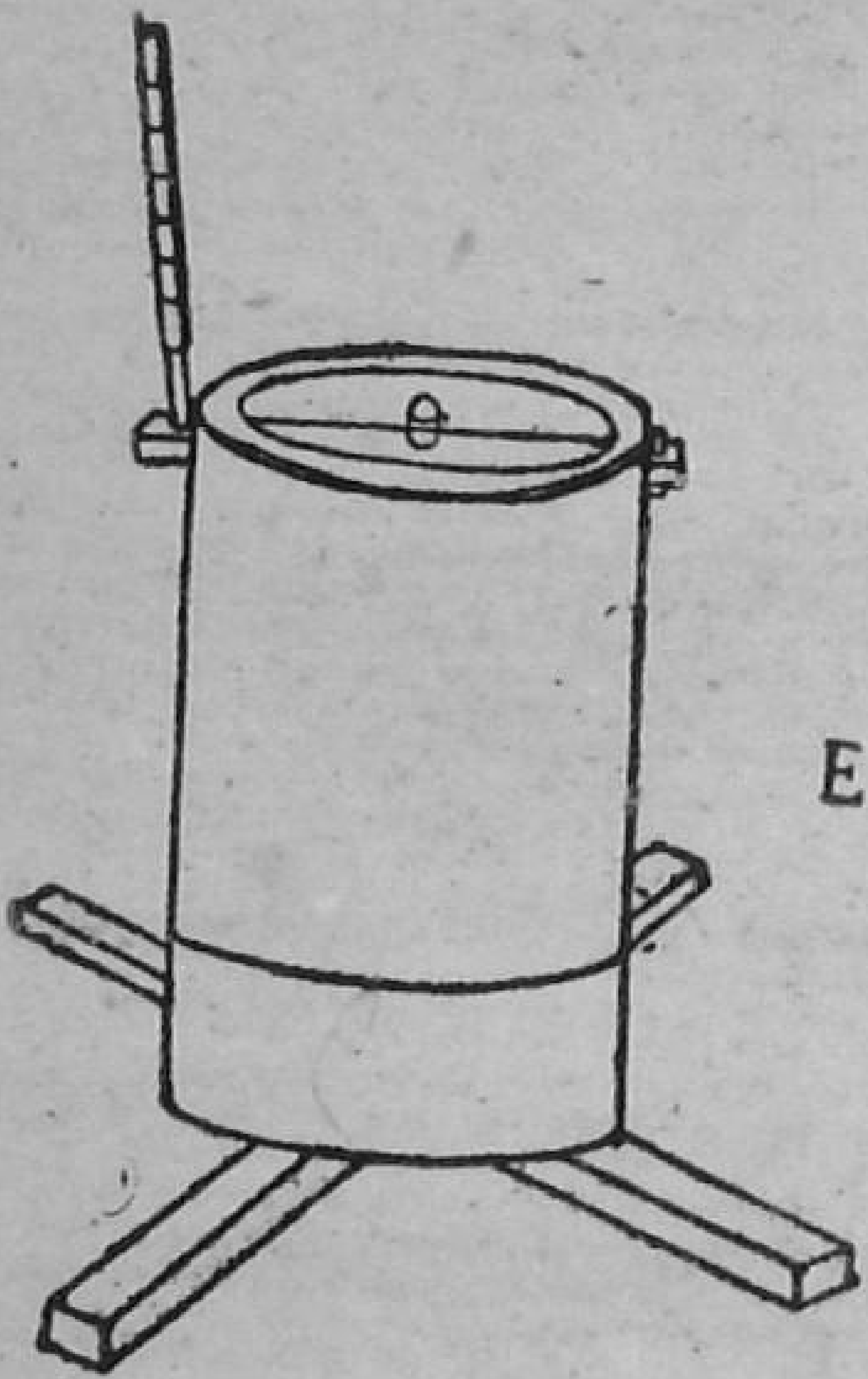
This is an exact but small model of the delain and can be worked by a woman. The big mills of Bengal are said to use it for testing the quality of paddy and rice before milling them in their machines. It can husk about 80 lbs. of paddy in an hour. The working surfaces slope downwards from the centre. The chakki should not be stopped abruptly when working, as then the paddy in the feeding whole enters the working surface and comes out unhusked. As this chakki is made along the grain of the wood, it is liable to crack in the summer and become useless. It costs about Rs. 4. (See sketch on the next page).

3. Maharashtra Wooden Chakki

This is a flat wooden grinder about 27″ in diameter and 12″ in height. It is commonly used in Ratnagiri District in

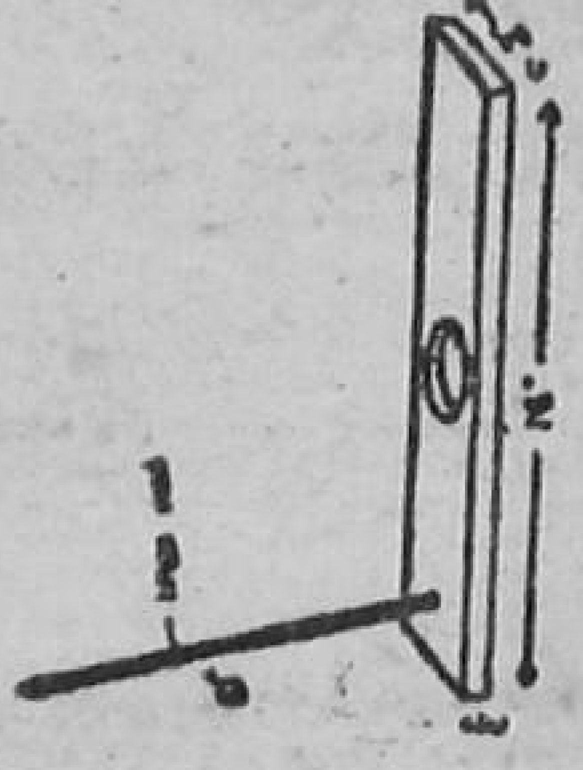


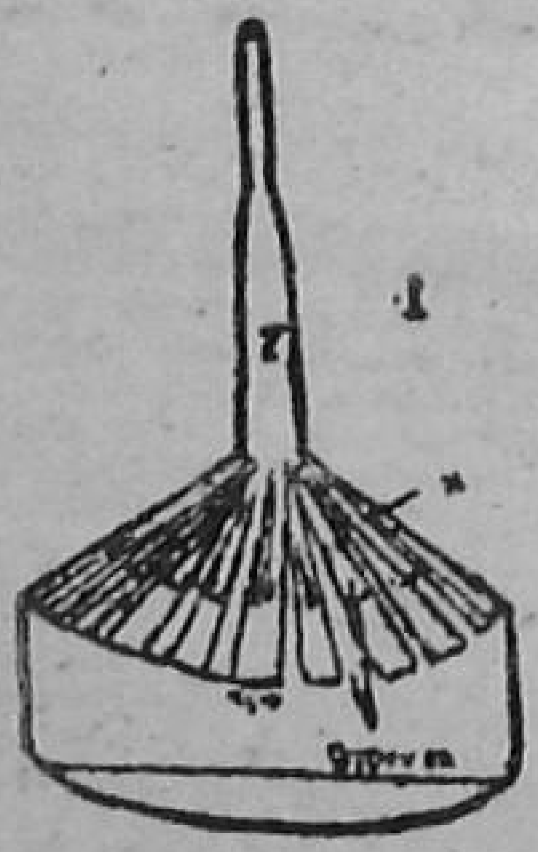




E

Cylindrical block
of wood
12" diameter.
17" high.





The corresponding inverted cave Y is grooved in a similar manner (See A). Grooves about ⅛th inch thick are cut from the base of the cylinder Z to the outer circumference where they are 1" apart. Interspaced between these are similar grooves extending from the base of Z ¾ the way of the cave.

the Bombay Presidency. It is a very useful instrument and its working is simple like any flour grinder. The outturn of paddy per hour is more than that of other chakkis. Its defect is that as it is made of mango wood, which is soft, the grooves in the working surface wear out very quickly *i. e.* within about a day or two of continuous work. Also its diameter of 27" makes it a little difficult to work. A diameter of 22" to 24" is a convenient size, chakkis which are anything more than this being comparatively inefficient as the speed of working lessens. An ordinary chakki of this type can husk about 60 to 80 lbs. of paddy in an hour. It costs Rs. 7.[1] (Pre war price)

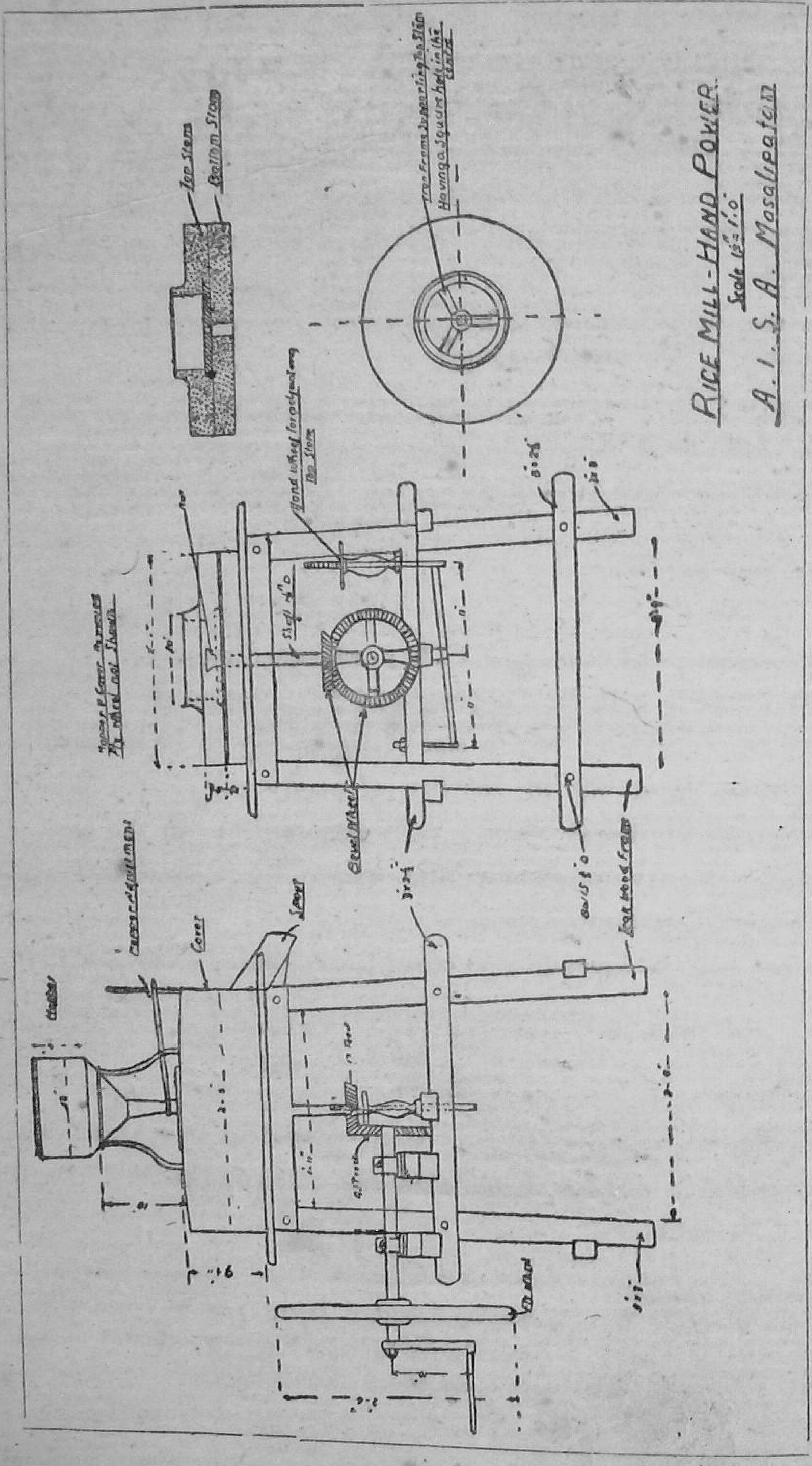
4. Stone Chakki

These are made out of a kind of soft stone found at Vile Parle near Bombay. They are used mostly in Gujarat. Each stone is 2 ft. in diameter and 3" in thickness. It can be adjusted according to the size of the paddy to be husked. It can husk about 80 to 100 lbs. of paddy per hour. But the percentage of breakage is a little greater than in the wooden chakki. Its advantage over the wooden chakki is that it can be worked without any repairs for a year. It is becoming popular and is spreading to other provinces. It costs Rs. 25.[2]

Recently an engineer from Mysore has successfully copied this chakki in cement and concrete.

In Bihar, a variety of stone found at Sassaram near Patna, has been found suitable for making the Vile Parle type of chakki.

1. Can be had from Shri Appa Sahib Patwardhan, Kankavali, Ratnagiri.
2. Can be had from the Bombay Suburban District Gram Udyog Sangh, Bhandar Vilbhag--399, Kalbadevi Road. Bombay 2.
3. Information regarding this can be had from the Gram Udyog Karyalaya, Muzaffarpur.



MASULIPATAM CHAKKI

5. Masulipatam Chakki

In Masulipatam an elaborate machine has been contrived in which the stone chakki described above is worked at a high speed by a two toothed pinion arrangement. The handle of the machine is rotated vertically by two men, standing. The outturn in this chakki per hour is nearly 1½ to 2 maunds. It costs Rs. 120.[4] (See sketch opposite).

6. Clay Chakki

Used in the rice growing tracts of C. P. It lasts only for a short period of 2 to 3 months after which it becomes useless and is thrown away. Clay is mixed with fibrous materials and chakkis of 16 or 18 inches diameter are made out of it. The upper disc rotates round a hole in a piece of wood which is imbedded in it and which passes right through the disc along its diameter. One end of this wood projects out and on it is fixed the handle for revolving the disc. As this chakki has to be completely dry before use, it cannot be prepared in the rainy season. So 5 to 6 are made in the summer and kept for the year. In some localities the upper disc of the chakki is baked. The instrument is generally heavy when it is new and requires even more than two persons to work. As it is made of ordinary raw clay, it wears out very quickly and the rice that is husked in it is generally coated with a thin layer of clay, which is a disadvantage, when the rice is eaten unpolished. The people, however, polish the rice in a dhenki so do not consider this a defect. The main advantage of this chakki lies in the fact that it costs next to nothing.

7. Bullock Chakki.

This is a small iron machine for husking and polishing worked by a single bullock, and found in use in Bihar. An iron

4. Can be had from the A. I. S. A. (Andhra Branch) Masulipatam.

bar with about 12 or 16 teeth is made to rotate in a cylindrical iron cavity. A number of bolts are fixed into this cavity to produce required friction. Paddy is fed through an opening in the top. One end of a wooden shaft is fitted to the iron rod in the middle and to the other end the bullock is yoked. The paddy is pressed between the teeth and the bolts, and is not only husked but polished at the same time. The grain comes out through an opening at the bottom of the cavity. As all the paddy that is put in is not husked in the first charge, the process is repeated 2 to 3 times. Finally the rice that comes out mixed with husk is separated and cleaned as usual. The defect with this machine is that the bran and husk are reduced to small particles and mixed together so that they cannot be separated, thereby wasting the bran, which could otherwise be used. It is claimed that this chakki can turn out 4 to 5 maunds of paddy in a day of 8 hours. It costs Rs. 25.[1]

8. Pestle & mortar

The mortar is of stone or wood with a hole about 8" deep and 6" in diameter. The pestle is of wood about 6 ft. long with an iron hub at one end and a ring at the other, so that it is used for husking and polishing according to requirements. About 6 to 8 lbs. of rice can be prepared in an hour by this method.

In some places earthen mortars just of the shape of flower tubs—wide at the top and tapering to the bottom—are also used. At the top they measure near about 2 feet in diameter and at the bottom about 9 inches. Both the surfaces are left open. At the time of operation this is placed over a flat stone that has been fixed on the ground. The receptacle is filled with paddy and pounded. The output depends

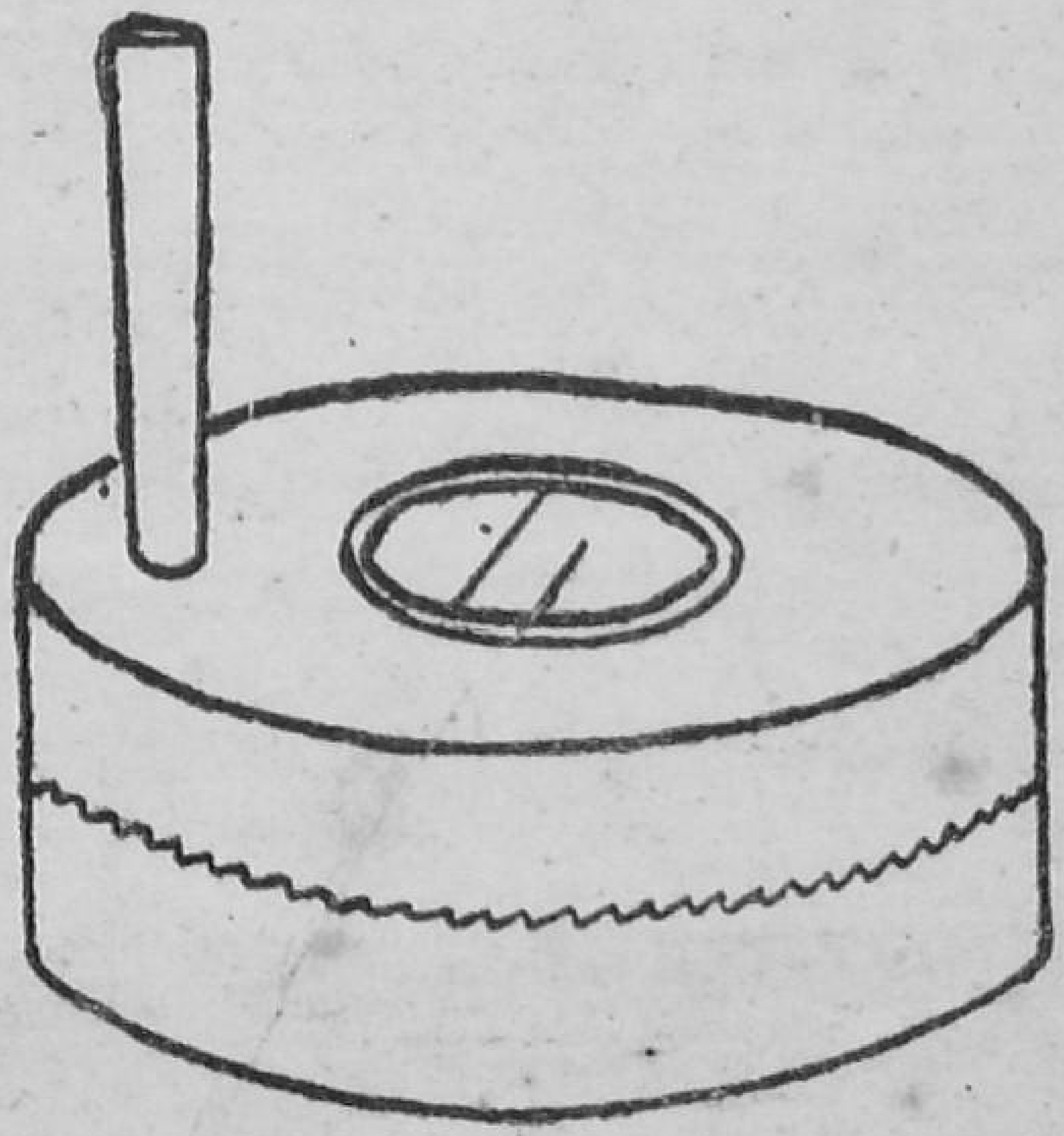
[1] Available from Shri Bhanamal Gulzarimal, Mithapur, Patna.

much on the experience cf workers. Generally 2 women pound the paddy in the mortar and another one sits nearby to winnow away the outer husk as and when the paddy gets shelled. Altogether 3 women can husk as well as polish one maund of paddy in the course of about 4 hours.

Wooden mortar is exclusively intended for polishing rice. Two women can polish 2½ maunds of unpolished rice in 6 to 8 hours.

9. Flat Wooden Paddy Chakki

We find that the easiest and the most efficient way of carrying on this industry on a cottage basis, is by means of a flat chakki based on the model of the Maharashtra chakki.

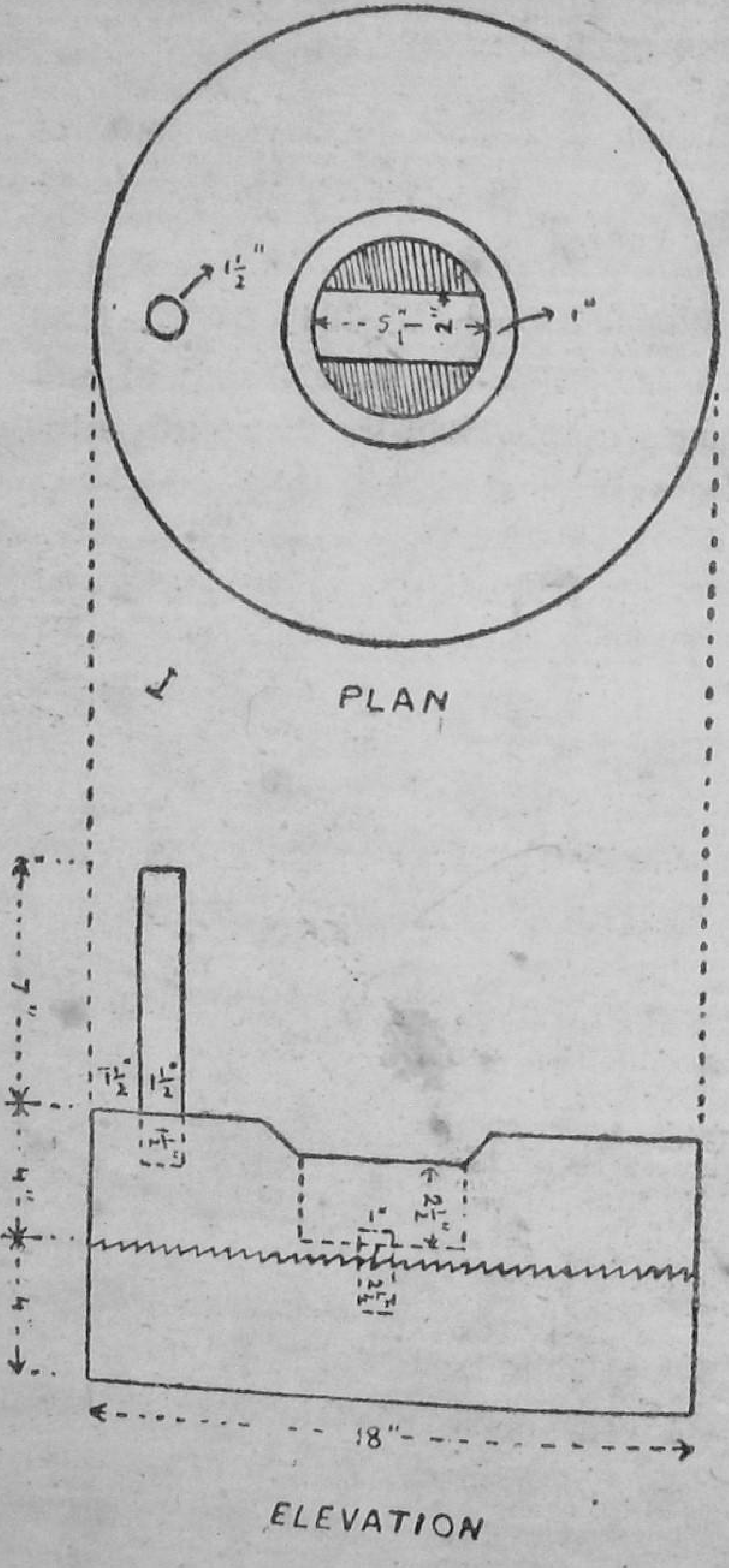


FLAT WOODEN PADDY CHAKK

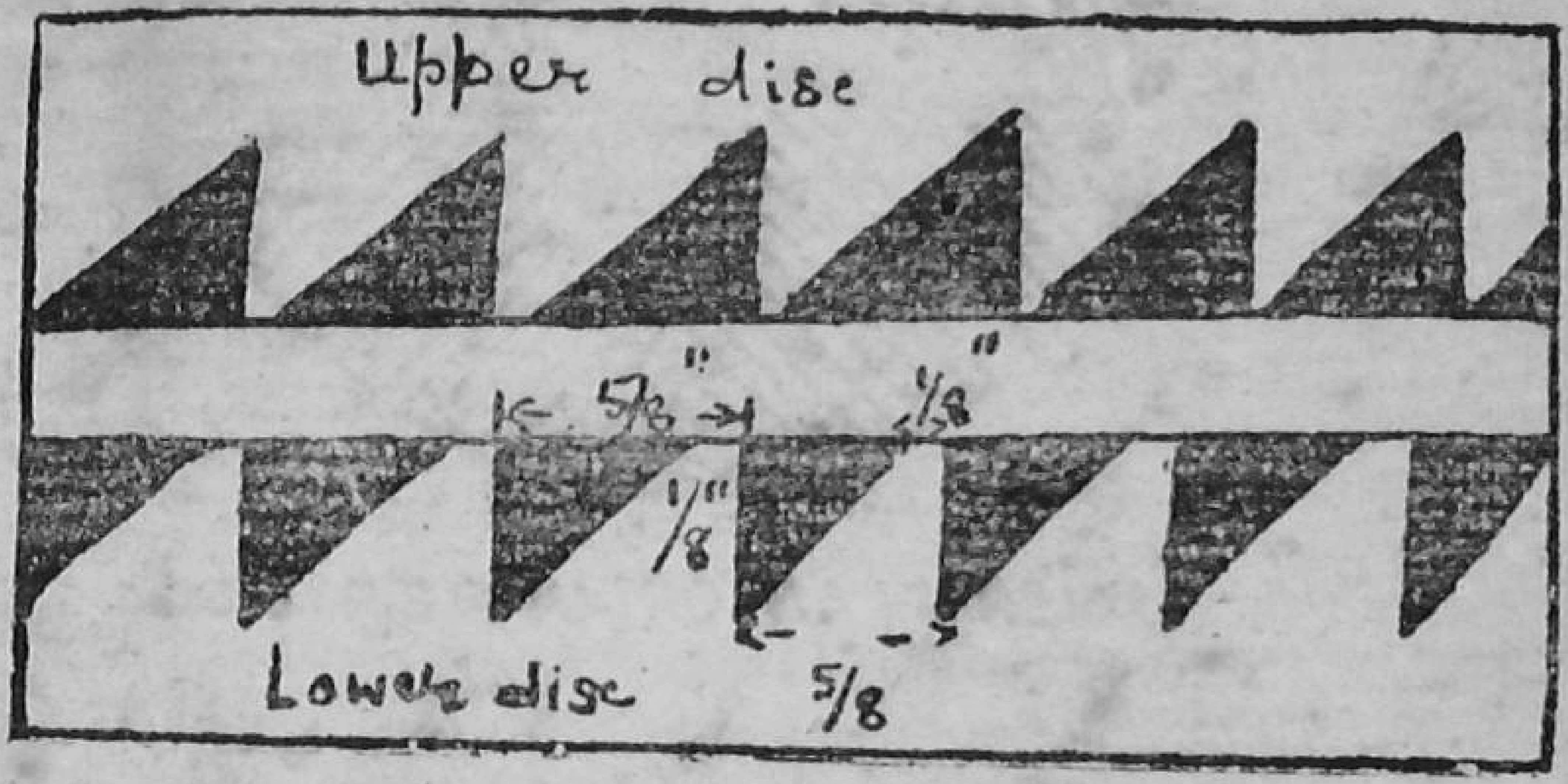
It is very much like any other chakki in appearance *i. e.* two discs, the upper rotating on a pivot fixed in the lower. The timber that is most suitable is any hard wood like Babul, Neem, Sirish, Sesam or Tamarind cut into length-

FLAT WOODEN PADDY CHAKKI

Scale 1½" = 1 ft.



wise planks 4 or 5 inches in thickness and more than 18 inches in diameter and 8 or 10 inches in height *i. e.* each disc is 4 or 5 inches in height. The surfaces of the discs that come into contact with each other are saw edged (as per following sketch) which makes possible the required friction to free the kernel from its husk.



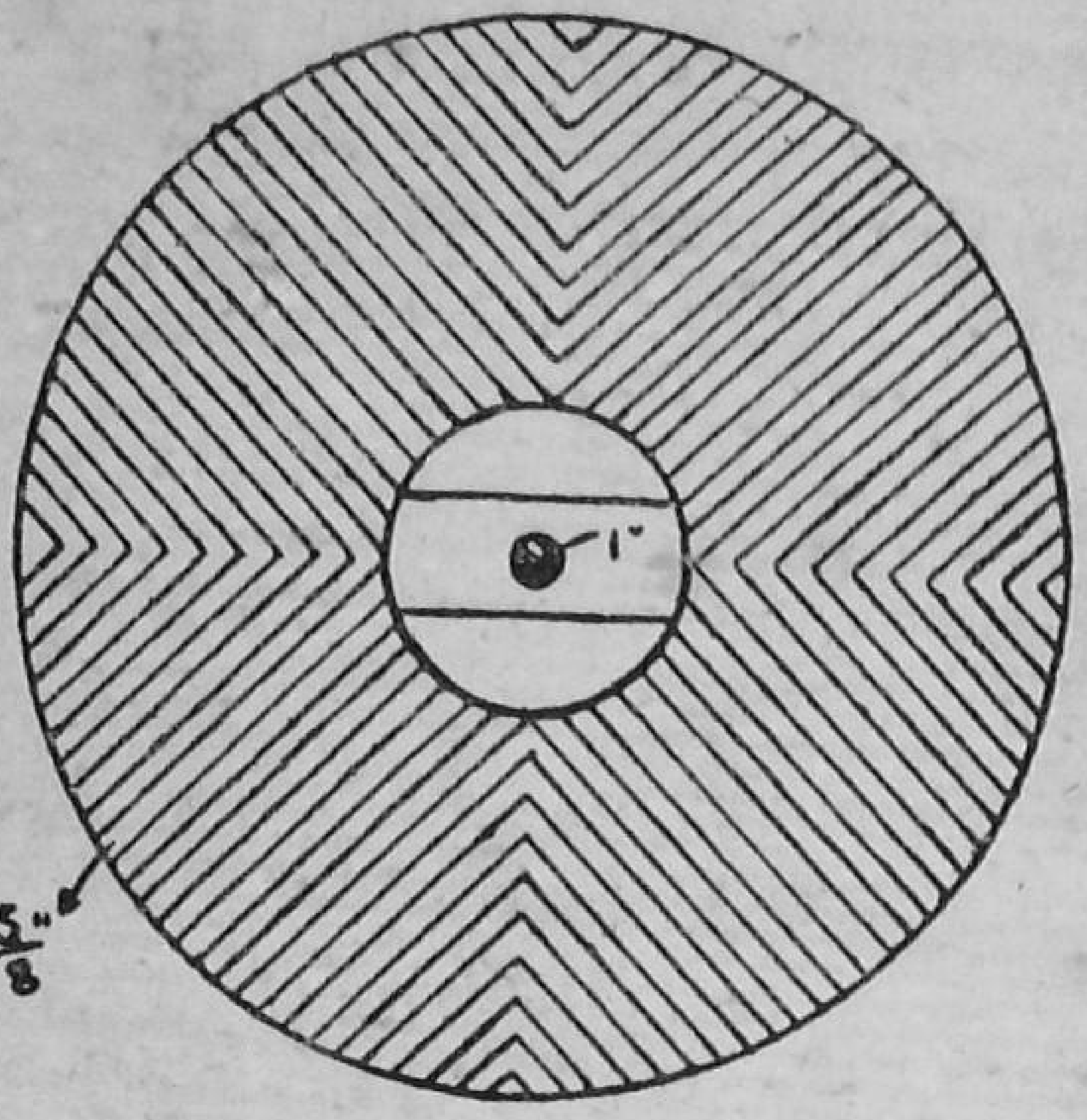
FLAT WOODEN PADDY CHAKKI

(Grooves Shown in actual-size)

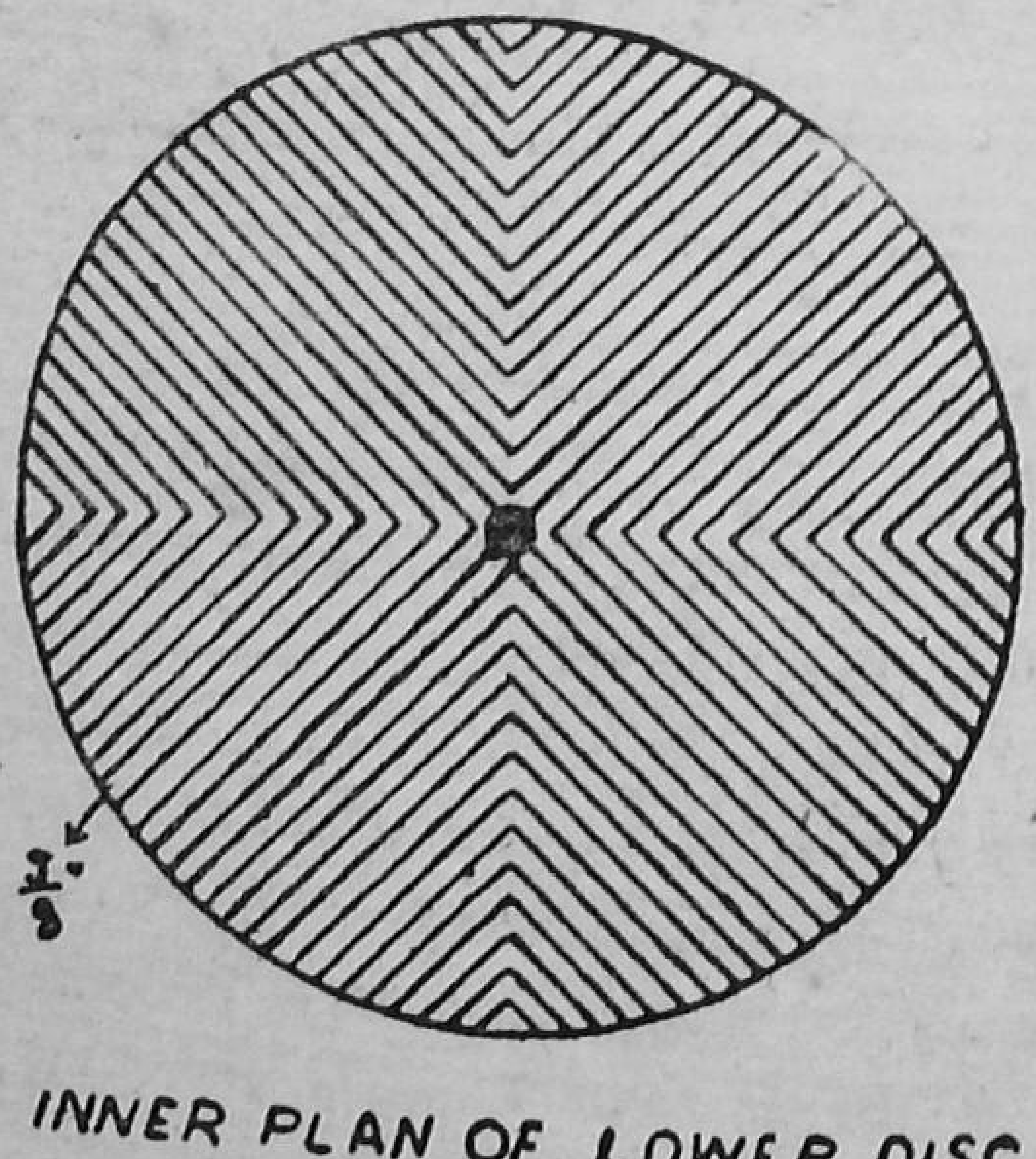
The grooves or saw edges are made as follows. Mark off two diametrical lines each intersecting the other at right angles, thus dividing the surface into four equal parts Each of these surfaces again has to be divided into two equal parts and lines drawn parallel to the dividing line at a distance of about $\frac{5}{8}$ inch from one another. At each of these lines the surface has to be cut in $\frac{1}{4}$" almost vertically as shown in the above sketch, and the shaded portion scooped off so as to allow $\frac{1}{8}''$ between the top of this vertical cut and the top of the sloping surface of the groove.

FLAT WOODEN PADDY CHAKKI

Scale 1½" = 1 ft.



INNER PLAN OF UPPER DISC



INNER PLAN OF LOWER DISC

In the centre of the lower disc is a wooden axle 1″ in diameter and 2½″ long, 1½″ of which is fixed in and only 1″ seen above the surface. On this pivot the top disc rotates in anti-clock-wise direction and around it is the receptacle for the grain. The feeder is made by completely scooping out two almost semi-circular spaces near the centre of the top disc. In the centre two concentric circles about 6″ and 4″ in diameter respectively, as well as two parallel lines, each an inch away from the centre, are drawn on the upper surface of the top disc, and the spaces beyond the parallel lines and within the smaller circle are scooped up. The space between the parallel lines left intact will form a bar across the feeding hole. The space between the inner and the outer circles is given a gradual slope towards the centre to prevent the grain falling off the sides of the chakki. For the same purpose, the upper surface of the bar is chipped off about an inch in depth. Similary the lower surface of the bar is also chipped off to a depth of ½″ thus making the capacity of the receptacle larger.

A notch is made in this lower surface of the bar by scooping up a surface 1″ in diameter to a depth of 1½″.

The handle for turning the chakki is fixed on the upper surface of the top disc at about 1½″ from the edge. The size of the handle is 1½″ in diameter and 7″ in height and fixed in to a depth of 1½″.

The worker at the chakki should sit on a stool to enable her to work at ease and in comfort. While with one hand she turns the handle, with the other she puts in the grain so that no time is wasted in feeding the chakki. The capacity of the chakki is 4 or 5 maunds of paddy in an eight hour day.

Breakage of the grain according to this method is only about 5% but this, of course, varies with the variety of the grain, the length of time it has been stored before husking, as well as the dryness of the grain. Sometimes breakage may be due to excessive pressure in the chakki which can be relieved by putting a tiny piece of cloth in the notch thus raising the level at which the upper portion of the chakki comes into contact with the lower. The quantity of unshelled grain that falls through need not be greater than 10% at the first charge, though this percentage goes on increasing as the chakki is subjected to greater wear and tear. When such is the case, lost efficiency can be restored by making the grooves afresh.

The chakki can be worked for about 3 days without renewing the grooves or for husking about 12 to 15 maunds of paddy. This may be a disadvantage to the grain dealer but it can be remedied if he has a spare set of chakkis, so that the work can go on continuously even when one set is under repair. It is eminently suited where only small quantities of paddy require to be husked, as in the home[1].

The great advantage of this method of production is that since the chakki only husks and does not polish, it makes for the consumption of nutritious unpolished rice. The time honoured implements, the dhenki, and pestle and mortar not only husk but partially polish as well. Consequently this chakki is better. Further, it makes possible the use of idigenous raw material (timber) and labour (village carpenter) for manufacture of the required implements. It thus brings about the proper utilisation of the country's material and human resources.

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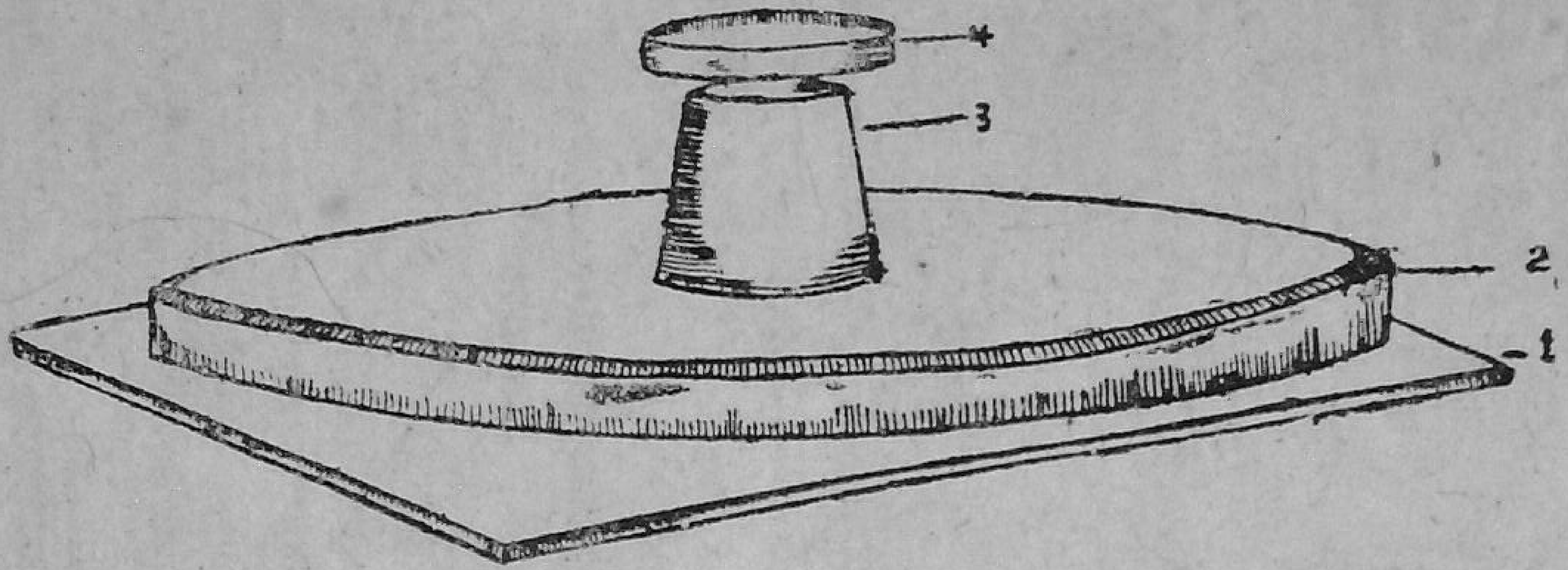
[1] It can be had for Rs. 12-8-0 from the A. I. V. I. A., Wardha, or a small wooden model of it for Rs. 1-8- can also be had with the help of which local carpenters can make the full sized chakki.

Accessories for making cement-concrete Chakki.



(To face Page 29)

Paddy Husking Chakkis Out Of Cem

Wooden chakkis, though they are ideal for obtaining wholly unpolished rico fit for human consumption, are attended with two main draw backs. (1). Proper wood of the required girth is not easily available. (2). The chakki requires regrooving twice a week in case it has got to be worked 8 hours every day. These two reasons stand in the way of its universal adoption So it has become necessary, to substitute a type in which both the above mentioned defects will be overcome.

Chakkis can be made out of reinforced cement-concrete, The equipment needed for the manufacture of such chakkis is as in the figure on the opposite page.

No. 1. Is a plain wooden board of 22″ square.

No. 2. Is a circular wooden frame of 20″ inner diameter and 2″ height.

No. 3. Is a wooden conical cylinder 4″ in height and 5″ diameter at the top and about 6″ diameter at the bottom.

No. 4. Is a smaller circular frame of 7″ inner diameter and 1″ in height.

No. 3 is used to make the opening in the middle of of upper block that is required to feed the chakki with paddy and no. 4 gives a bank or border on the top of this opening. This will serve in preventing the paddy from being thrown out on all sides.

Take one part cement; two parts of coarse, clean sand and four parts of stone pieces (2 parts 1″ thick and 2 parts ½" thick) and make them into morter.

The stone pieces used should be of brick and not of granite pieces. Granite pieces in this chakki will not only make the chakki heavier but they may affect the proper functioning of the chakki. Brick pieces will get worn and thus save the paddy from breaking too much.

In order to reinforce the block, iron gratings will have to be given inside. Make two rings 8″ and 18″ in diameter with 3/16″ thick iron wire. Keep them concentric and connect them with four or five spokes made of the same size of wire.

Keep no. 2 over no. 1 and no. 3 in the centre and fill the frame with the morter to about one inch. Fix the iron grate and again fill to the brim of the frame (i. e. 2 inches height). Keep no. 4 around the top of no. 3 leaving a regular space of 1″ all round. Now fill this space with the morter. This makes the upper block of the chakki. The morter will settle and will become partially hard in about 3 hours. Remove no. 2 gently. Keep it again on a plain wooden surface and fill it with morter to make the lower part. This time no 3 and 4 are not required. Simply hold a wooden cylindrical peg 1″ in diameter and 4″ in height in the middle of the frame. This will serve as the central axle for the chakki. After removing the cement blocks from the frame they have to be kept under water for nearly a fortnight in order that they become completely hard. After that they are removed and a wooden crosswood, as in the wooden chakki, is fixed on to the upper part in the mouth portion and can be used. If necessary the surfaces can be dressed by a sharp chisel to produce the required roughness.

Such kinds of chakkis can be made in all the places and each pair may not cost more than Rs. 6/- inclusive of labour charges.

POLISHING

Although as stated above polishing of rice is destructive of the body building materials in the rice grain and it is, therefore, not advisable to polish it, still if people wish to polish it to some extent and use the bran separately, they may do so. For polishing, the pestle and mortar or the dhenki is used. The pestle and mortar[1] turn out less work than the dhenki.

10. Dhenki

The dhenki consists of a wooden beam working on the see-saw principle fixed to a pivot. To one end of a beam is fixed a short pestle and this drops into a wooden mortar fixed in the ground. The mortar is filled with the grain and the worker treads on the end of the beam opposite to the one to which the pestle is fixed and thus lifts the pestle two or three feet above the mortar. By suddenly releasing the pressure on the beam the pestle drops with force into the mortar and husks the paddy contained in it. After a certain amount of shelling is done, the grain is removed from the mortar, the separated husk winnowed away and more unshelled grain put in. When the whole shelling is finished the rice is polished in the same mortar. We have found that fixing a double faced pestle adds to the efficiency of the ordinary single pestled dhenki by increasing the output. It polishes 2½ mds. of unpolished rice in a day of 8 hours and costs Rs. 15/-

As in the case of the chakki, babul or any other hard wood serves the purpose. The lever beam is parallel to the ground and 7½' in length and about 6" in diameter. At one

1 Described under 8 above.

2 It can be had from the A. I. V. I. A., Maganvadi, Wardha, packing and freight extra.

end of the beam, about 6" away from the extremity, is fixed the pestle which is obtained by shaping a piece of wood 2' x 9" x 3". At the tapering end of the pestle is fixed an iron ring.

About $2\frac{1}{2}$' away from the end opposite to the one where the pestle is fixed, a fulcrum rod is fixed to the lever beam. The rod 2' x $1\frac{1}{2}$" x $1\frac{1}{2}$" is passed through the lever in such a way that 8" of it projects on either side. These projections are made cylindrical and are supported by two other cylindrical posts each $4\frac{1}{2}$" long and 4" in diameter. Of the $4\frac{1}{2}$' only 14" need be above the ground. To enable the fulcrum to rest on these supporters, a socket is made in each of them to a depth of 7".

At the shorter end of the lever a pit in the ground is made about 2' deep and broad enough to allow the lever to pass through it when worked. Above this pit a cross bar about 5' high from the ground level is fixed, to which the person holds on when working the lever. At the pestle end a mortar made of wood about $1\frac{3}{4}$' x $1\frac{3}{4}$' x 1' is fixed into the ground in such a way that when the pestle rests on it the lever becomes completely horizontal.

As the mortar is round in shape with a bulge in the waist, the contents of it, when beaten by the pestle, get pushed up the sides in a circular motion and fall automaticaly towards the centre, thus eliminating the necessity to push back the grain into the mortar by hand. Hence only one person is required to work the dhenki. This round shape of the mortar also causes less breakage of rice as the grain, instead of being beaten between the pestle and the flat bottom, merely gets pushed up the circular sides and the friction so caused polishes it.

In order to get the bran in a clean state free from grit, a wooden funnel about 9" high is fixed on the mortar.

This funnel prevents the rice from coming into contact with the earth. If the bran is to be used for human consumption care should be taken to see that the whole rice to be polished is free from paddy and other foreign matter. After beating is done, the rice and bran are separated with a sieve or winnower.

30 lbs. of unpolished rice can be polished in an hour and such rice gets polished to nearly 10%, *i. e.* 10% of the weight of the rice is separated as bran. If the degree of polishing required is less the outturn will increase proportionately. Even in the first process of husking the rice gets slightly polished, so that while consumers of unpolished rice may not like the use of the dhenki, others may welcome it

11. Winnowing Fan

Hand winnowing takes about 30 per cent of the time spent in the process of husking. Time and labour in winnowing can be saved be using a fan that is being worked in some parts of the country where paddy is husked in large quantities. The fan is useful for other grain also.

The construction and working of the fan are simple. Five or six planks are fixed to a cylindrical axle which is made to rotate in a covering made of wood or tin, having only one opening, through which pass both the grain and the husk. The husk is carried away by the wind and the grain being heavy, falls to the ground. A second chamber may be attached to the main covering in order to check the husk from spreading everywhere.

This fan will cost about Rs. 50 and does about ten times the work possible by hand winnowing.

CHAPTER III

THE RICE POUNDING INDUSTRY

There is a feeling current that village and cottage industries, carried on in the decentralized manner with the help of very simple implements and run by man and animal power, cannot stand the competition of centralized large scale factories, equipped with efficient labour saving machinery and worked by cheap natural power. To view it from the stand point of national economy, however, it is necessary to study each industry separately, examining the efficiency of its working in relation to society as a whole.

The first care of any national economy must be to find employment for all the human and animal power available in the country. If any other power replaces that of man and animal on the ground of its being cheaper, the unemployed will have to be fed by some other means. If, then, the cost of maintaining such unemployed is added to the cost of the so called cheap power, its cheapness may prove to be a delusion. In other words, no method that keeps human beings and their associates, the animals, unemployed, can really be cheap from the point of view of the nation.

If such power is to be used it should be only to supplement the work of man and animals and to lessen their drudgery and exertion; never as a substitute unless we are prepared to take the ruthless course of destroying all the unemployed. Such power then should not be applied to industries which can usefully employ the spare time, which millions of our people have. Utilization of spare time, which is the cheapest form of power, will be a great national gain.

1. Rice mills and unemployment

Home pounding of rice in India is both a whole time and a spare time occupation. Where it is carried on for commercial purposes it is done by whole time labourers, and when for home consumption, it is done by consumers themselves in their spare time. The introduction of rice mills has affected both kinds of people. The following table gives an idea as to how many persons are thrown out of employment by rice mills.

Place	Method	Amount of paddy treated (in Mds.)	No. of persons employed	persons that can be employed if rice is home pounded
Bulsar (*Gujarat*)	Home pounding	$3\frac{1}{2}$	5	5
Bardoli (*Gujarat*)	Rice Mill	105	5	150
Tumsar (*C.P*)	,,	280	14	400
Guntur (*Andhra*)	,,	360	40	515

These figures show that as the size of the mill increases, its capacity to displace persons also increases. As will be explained later on[1], the cost of preparing rice by home pounding is not very much more than that of preparing it in mills. Therefore, there is no justification for the tremendous unemployment created by mills.

2. Are rice mills a national gain ?

It is necessary to distinguish between centralization of industries for efficiency and centralization for private profit. Some key industries have to be run, if they are to be run

1 See pages 38—41

efficiently, in the centralized form. But they must be carried on in the interests of the nation. On the other hand, centralization, which results in a few becoming rich at the cost of the many, does not increase national wealth computed in terms of human welfare. The rice mill is a glaring example of centralization not for efficiency but for private profit, when the greed of the few is allowed not only to rob the many of their spare time occupation but also to spoil one of the nation's staple articles of food as has been shown in Chapter 1.

Moreover, the common notion that centralization is an efficient form of organization for industries, needs to be revised. As such industries work on a large scale basis they need expensive machinery imported from abroad and have to deal with distant markets, both as regards the supply of raw materials and the sale of finished goods. Therefore, in such industries cost of machinery, collection of raw materials and marketing of the finished product assume serious proportions, and heavy expenses on this account have to be met on depreciation of machinery, repairs, buildings, interest on capital invested, freight, commission, advertisement, storage, insurance and other items. On the other hand, as small scale industries employ cheap locally made instruments and cater to local markets, they do not have to incur such expenditure. In some industries, in which very simple operations are involved, the margin of saving in production by factories as compared with village industries is just enough to cover these extra items of expenditure incidental to factory production, so that in their case the cost of production, whether in a factory or on a village industry scale, is practically the same. In food articles such as rice, where nutritive value is affected adversely by the use of large scale machine there is all the greater reason to favour village industries.

If, as a matter of fact, in practice we find that such hand made products are dearer than factory made ones, the reason is not so much the greater efficiency of the factories as their power to employ capital and to control raw materials and markets with the help of capital. This is particularly true in India, where decentralized village industries are not afforded fair opportunities as against the well provided for and organized centeralized factories. Such being the case, it is not possible to conclude that if factory goods are cheap it is because of the greater efficiency of large scale production.

3. Consumption of home pounded rice

There is no doubt great scope for the improvement of instruments in use in village industries. With such improved instruments it will be easily possible for home pounding of rice to come back to its own. In fact, in spite of the inroads that rice mills are making in villages, and in spite of the inefficiency of the instruments of home pounding, the bulk of the rice consumed in India is, even now, home pounded as shown in the table [1] below.

	Province.	Percentage of the rice eating population using hand-pounded rice (1938)
1	Bihar	90
2	Assam	85
3	United Provinces	85
4	Orissa	80
5	Bengal	75
6	Hyderabad	70
7	Travancore	45
8	Madras	30
9	Burma	20

1. The Rice Problem in India P. 71

It will be seen from this table that all the rice-eating tracts, except Madras, have more or less adhered to the indigenous method of preparing rice, namely hand-pounding. It is only in Madras that machine-milling of rice has made the greatest headway, practically destroying the custom of hand-pounding. There rice mills have penetrated even into small villages. Apart from thus milling its own rice, Madras also imports large quantities of rice from Burma. And this has necessarily to be machine milled or polished, for when rice is unpolished it does not keep for long, as it is attacked by insects which seem to know better than we do what is good for them as food and what is not. So while they attack unpolished rice, they leave polished rice alone It was precisely because of this that traders, who were interested in shipping large quantitise of rice abroad, introduced rice mills for polishing the rice, for it was necessary that the rice so sent out should keep for an indefinite period of time. But mill polished rice, as we have already seen, is deprived of Vitamin B_1 which is a preventive of beri-beri, with the result that we find a higher incidence of beri-beri in the Madras Presidency, especially in those parts such as Andhra, where only raw (not parboiled) milled rice is consumed, than elsewhere in India.

4 Cost of hand- pounding *vs.* machine-milling

To compare the cost of preparing rice through machine-milling with that through hand-pounding, we give below a table showing the cost of preparation of 2½ maunds of rice through these two methods. We have taken the figures for the same area, the mill being located in the Bardoli Tahsil and the hand-pounding done in the adjoining Bulsar Tahsil of the Surat District in Gujarat. It must be noted that the hand-pounding of rice is done on a commercial scale in Gujarat

by a special community called 'Gola', which has acquired great skill in the art and does it very efficiently'. That is why inspite of the high wages of 6 annas a day paid to women doing this work the cost is comparatively low.

Cost of pounding 2½ Mds. of rice

	UNPOLISHED			POLISHED			
	Rs.	As.	Ps.	Rs.	As.	Ps.	
In mill	0	6	0	0	8	0	
By hand-pounding	0	6	0	0	15	9	Once polished
				1	5	0	Twice polished

The cost of preparing unpolished rice is the same whether in a mill or by hand-pounding, In confirmation of this we are told that at Bareja, near Ahmedabad, when mills could not cope with the work of dehusking, they employed human labour for the purpose without suffering any loss. This fact is of special significance. It means that if unpolished rice or merely dehusked rice alone is consumed, mills will not find it profitable to work. Further, as the labour involved in husking, *i. e* producing unpolished rice is light as compared with that required for polishing, women will husk at home with the help of the flat grooved chakkis already described, so that there will be little or no incentive for them to go to the mills for this purpose.

A study of the distribution of cost as between husking and polishing in the case of the mill and in hand-pounding is instructive. If the mill only dehusks paddy the cost is 6 annas for 2½ maunds. If it also polishes rice along with dehusking paddy, the additional cost for polishing is only 2 annas, as all that is required is to work a further part of the plant, the other expenses such as maintaining the staff, the initial power consumption etc. remaining constant. This

means that polishing in the mill adds only 25% to the cost of dehusking. In the hand-pounding of rice, on the other hand, the two processes of dehusking and polishing are quite independent of each other and whether they are done at a time or separately, each costs fully as a separate process. In other words, while the ratio of cost of dehusking and polishing in a mill is 3 : 1 it is reversed in the hand process if rice is subjected to two polishings. Hence hand-polished rice becomes expensive as compared with mill-polished rice. The figures given show that the second polishing alone costs 5¼ annas more for 2½ mds. of rice. This indicates the chances of reduction of cost in hand-pounding if the degree of polishing is reduced, while in the case of the mill the cost will be affected very little by reducing the degree of polishing. Both as regards the capital required for equipment and the recurring expenditure, the additional costs for the mill are very little for polishing, the major portion being required if paddy is only to be dehusked. Mills, therefore, are interested in popularising highly polished rice, for that gives them an advantage over the hand process.

It is clear then, that the advance of the mill is only in polishing. This is borne out by the general information received from another place also. In Tumsar, C. P., we are informed that about seven years ago people husked their paddy at home and brought the whole rice for getting it polished in mills. When the mills began to charge a flat rate for polishing whole rice as for preparing polished rice from paddy, the custom of husking paddy at home was given up.

The mill owner in question charges a flat rate of 10 annas for preparing 2½ mds. of rice adding 2 annas as his profit to the actual cost of 8 annas shown in the table above.

Thus there is a difference of 6 to 11 annas per $2\frac{1}{2}$ mds. as between milled rice and hand-pounded rice, which comes to $2\frac{1}{2}$ to $4\frac{1}{2}$ annas per maund.

This lower cost of machine-milled rice cannot, however, be regarded as pure saving. Loss in nutritive value of milled rice has already been discussed. There is also some loss occasioned by broken husk getting mixed with the bran. Besides, extra expenditure is involved in cart hire for taking paddy to the mill and rice back home. People do not care to take the husk back as it involves further cartage and so it is lost to them for use as manure or fuel in the village. All told, therefore, the apparent expensiveness of hand-pounding is amply compensated for.

Moreover, the cheaper rates charged by rice mills for preparing rice are not always due to lower cost of production, but also to the element of competition on which they work, as will be seen from the profit and loss account of one of the small rice mills working in Tanjore District, Madras Presidency.

Cost of plant, equipment, running charges, interest, depreciation etc.

Per day	Rs. 0-13-8
Daily working charges	„ 3--3-2
Total (Expenditure)	4--0-10

Daily income at one anna per kalam on 35 kalams of paddy	2-3-0
Daily income from flour mills	0-4-0
Total (Receipts)	2-7-0
Loss per day	1-9-10

if the old rate of $2\frac{1}{4}$ annas per kalam of paddy is charged for husking, as it was before competition, the income per day for husking 35 kalams would be Rs. 5-7-6

The gain per day would be Rs. 1-6-8

5. Difficulties in the way of hand-pounding

If the mill scores over the hand-pounder then, it is only in the production of highly polished rice which, as we have already pointed out, is deprived of nutritive value. If nevertheless, milled rice is steadily making headway against hand pounded rice, it is not only due to ignorance on the part of consumers in regard to the superior nutritive value of hand-pounded rice but also due to–1. the straightened finances of villgers, 2. the low physical vitality of women and 3. the low purchasing power of the people.

The first difficulty is well described by Dr. Pattabhi Sitaramayya, in the " Rice Problem in India " in the following words. " Home pounded rice means home storage of paddy. Most of the small land-holders own not more than 2 or 3 acres and they are in debt. What little paddy they grow is sold out in a lump, perhaps at the very field itself, in order to meet the liabilities of debt or some expenditure incurred by social ceremonies or the purchase of cattle, construction of house, and so on. In the months of January and February (harvest time) capital expenditure awaits the land-holder, which has to be made immediately and can only be met by the sale of paddy. For the time being the householder is able to meet the capital expenditure by selling his paddy and live on credit till the beginning of the next year, when again the sale of paddy will enable him to meet his existing and future libilities. In effect then, the villager has no paddy to pound." The problem today then, for hand-pounding as well as for most village industries, is one of retaining the necessary raw materials in their place of production for being converted into consumable goods by local artisans. But the financial condition of the people leaves them helpless to prevent the drainage of their raw materials.

The second factor, equally responsible for gradually putting an end to the practice of hand-pounding of rice, is that our women are exhausted by mal-nutrition, ill-health and continuous child-bearing, and instinctively avoid undertaking extra work demanding physical effort. They regard the advent of rice mills as a blessing. This is also the result of men leaving the whole of the task of preparing rice to women. If the present process, followed in some parts of the country, of pounding paddy in a mortar with the help of a pestle for both the husking and the polishing operations, is divided into grinding on a chakki for husking, and beating in a dhenki for polishing, it will enable men, who now regard working at the mortar and the pestle as a woman's job, to do the harder part of the process namely beating in a dhenki, leaving the lighter operation of grinding to women. This division in the process will also make it possible for us to obtain whole, unpolished rice on the one hand and pure bran on the other, which is not possible when both the husking and the polishing are done with the pestle and mortar. As indicated in the chapter on instruments the strain involved in winnowing can be reduced by using the winnowing fan.[1]

There is also a third reason for the spreading of machine milling of rice. As stated above the labour necessary to pound a maund of rice is 2½ to 4½ annas more than that demanded by the mill for machine milling the same quantity. The monthly requirement of an adult man, consuming rice as his staple food, may be estimated at half a maund (40 lbs). The consumption of hand-pounded rice in the place of machine milled rice will increase the monthly expenditure of rice by about 2 annas. Thus for an average family containing four consumption units, the extra cost will

1. Page 33

be about 8 as. Where rice is not the only staple food but is taken along with other cereals, the extra cost of hand-pounded rice over machine-milled rice may come to about 4 annas per month for a family. This is nothing compared with the return that accrues from the superior food value of home pounded rice. Further, as unpolished rice is richer in nutritive in gredients, less of it will be consumed than polished rice, so that actually, though hand-pounded rice may be a little more expensive than mill polished rice, it may be a saving to use hand-pounded rice, as less of it will be consumed. But poor people, whose purchasing power is low, do not have the patience to appreciate all this and purchase the apparently cheaper article of the two. This but points to the necessity of educating the people in this regard and inducing them to prepare rice themselves and save whatever amount is spent in getting it done in mills.

CHAPTER IV

PRACTICAL SUGGESTIONS

We have considered the food value of rice, and seen how by machine-milling and polishing, this staple food of a large percentage of our people, is not only deprived of much of its nutritive value, but is also rendered injurious to the human system. We have now to bring together suggestions which may be made for ensuring that the rice-eater obtains the utmost from the rice which he consumes. This may be considered under two heads. What may be done —(1)by the individual, and (2) by the State.

1. THE INDIVIDUAL

1. Washing & Cooking

We have already pointed out that much of the vitamins and mineral salts of rice are lost in washing and in faulty methods of cooking, where excessive water is used and thrown away. The easiest way of raising the nutritive value of rice is not to wash the rice much before cooking, and to cook in just enough water, so that no water is left to be thrown away. Even if some rice water is left from cooking, it should be used in preparing curries and vegetables, and by no means discarded.

2. Parboiling

We have also noted the good effect of parboiling. If polished rice must be eaten, it should be first parboiled and then polished; for parboiled rice, even when highly milled, retains much of its food value. If people will not at once change over to the use of merely dehusked or wholly

unpolished rice, it is necessary to induce them to take to parboiled rice being the second best. Further, rice just harvested can be immediately consumed if it is parboiled, whereas raw rice has to be kept for a few months before it is fit to be consumed. This gives an additional advantage to parboiled rice.

PARBOILING OF PADDY

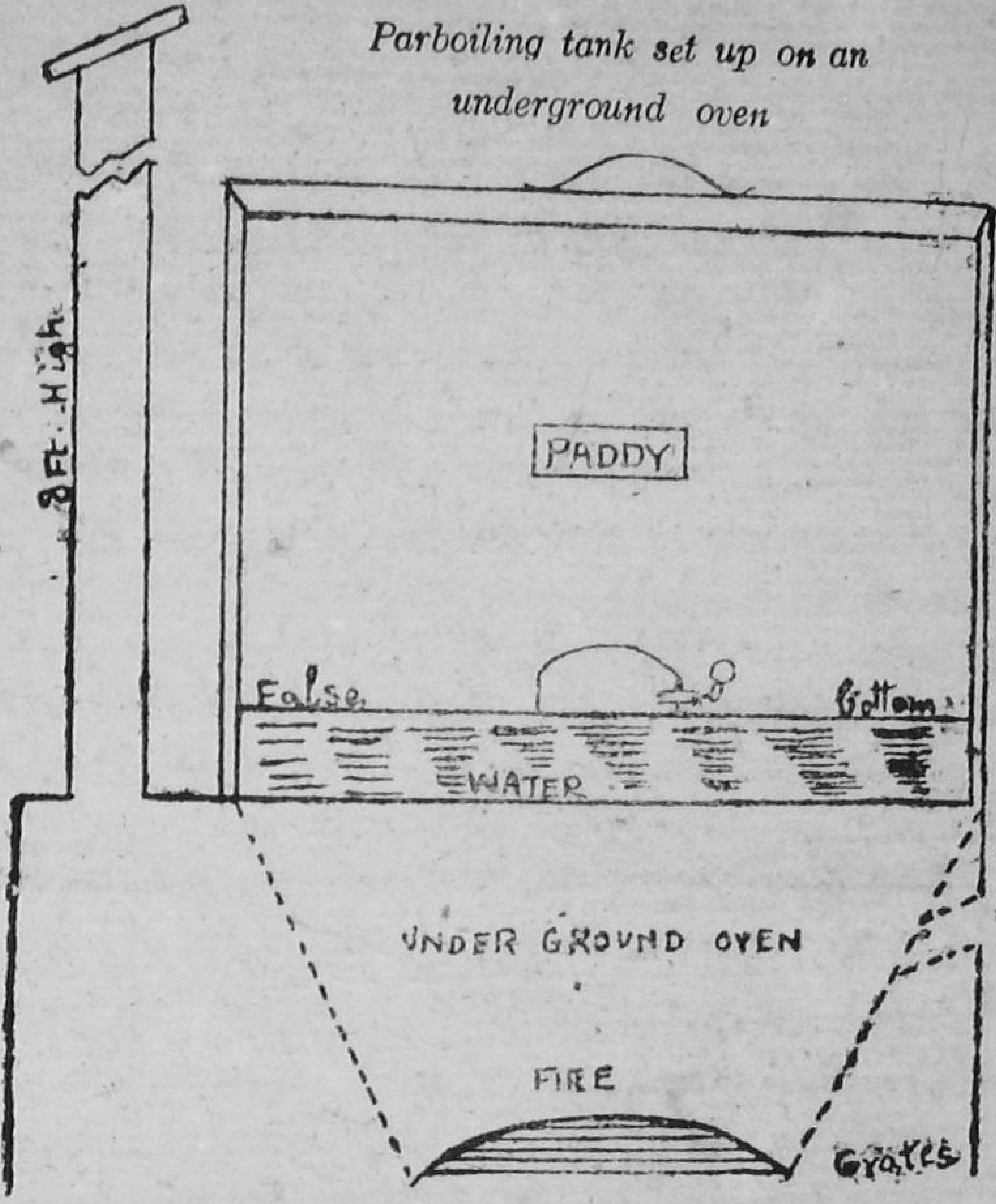
The process followed in some of the big rice mills is too elaborate and cannot be imitated by the villagers. The ordinary village process of parboiling with pots, either earthen or metallic, is too tedious and slow. So it becomes necessary to take advantage of a method where sufficient quantity of paddy can be handled in a comparatively short time with ease.

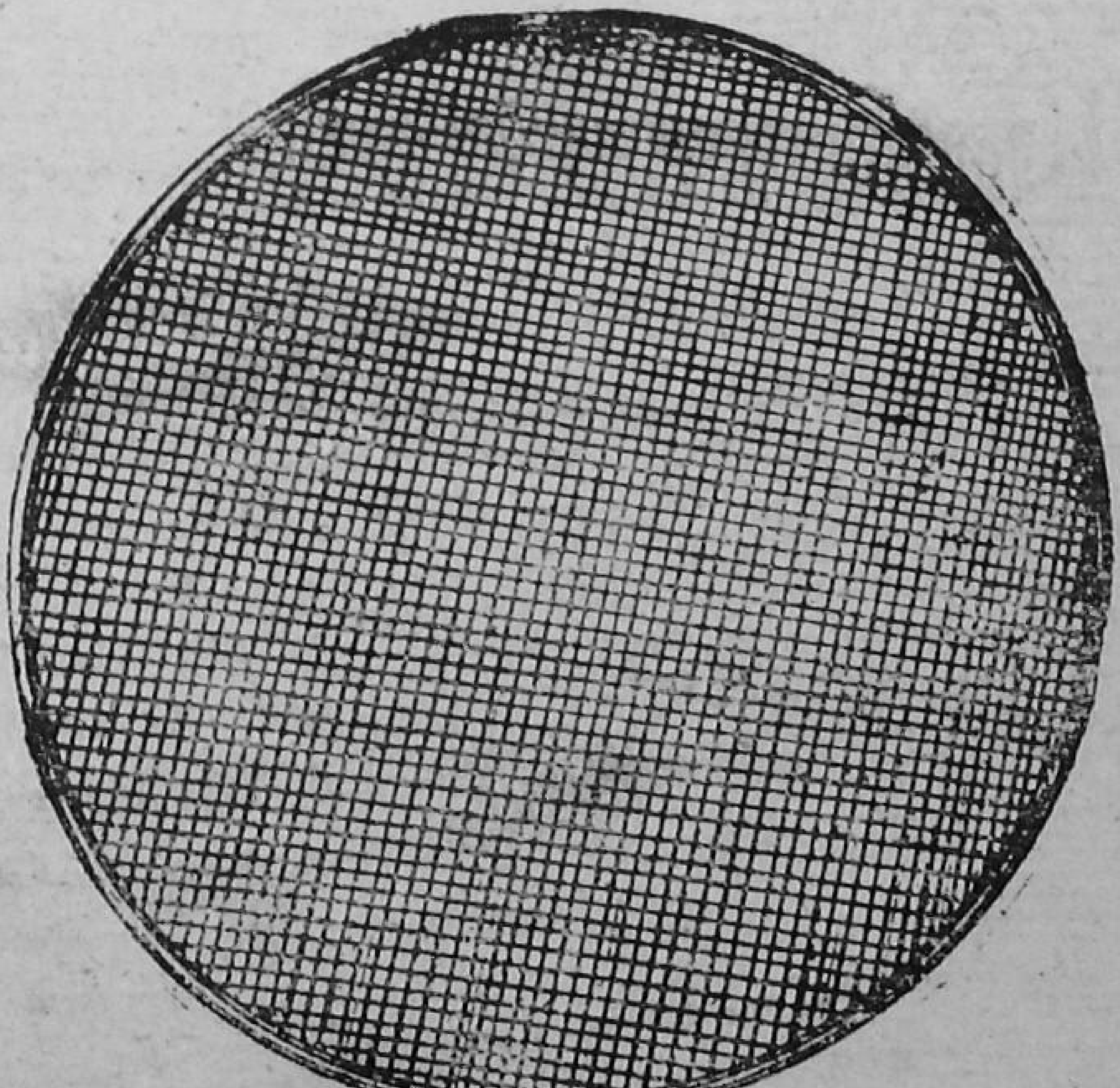
Improved method of parboiling

The equipment needed is an iron tank, cylindrical in shape, about 4 feet in diameter, and 4 feet in height. The bottom and sides are well rivetted or welded. For the top there should be a lid removable, with handle attached to it. At a height of about 8 inches from the bottom, fix some clamps in the inside of the tank. On these clamps the false bottom rests.

There should be a small outlet on the side of the tank to let out the paddy when parboiled. False bottom is used to hold the soaked paddy in the tank, just a little above the surface of the water. The steam issued by the boiling water should penetrate into the heap of paddy above, and hence the false bottom should be full of small meshes that will not allow the paddy to pass through. Strong wire mesh can be made like the one shown in the figure opposite, with tight iron bands on the circumference. Also a thick plate of iron can be perforated for the purpose.

Parboiling tank set up on an underground oven





Front view *False bottom*

How to use the tank? The tank should be fixed on to a permanent underground oven. Fill the tank with water up to the level where the false bottom is fitted. Above the perforated false bottom fill soaked paddy. Cover the lid. Ignite the fire. Now the water boils and issues steam which, in turn, parboils the paddy above. After the charge is over, open the small outlet on the sides of the tank, to let out the paddy. Brush the inside of the tank and completely bring out all the parboiled paddy. Now fill in a second charge. This time it will be parboiled quicker than before. On an average each charge will take about 40 minutes. Generally about 15 maunds can be parboiled every time.

3. Consuming coarse rice

Coloured and so called coarse varieties of rice, discarded by the well-to-do because of their appearance, are generally richer in nutritive value than the white and fine varieties, which command a high price in the market. They contain largequantities of proteins and minerals, particularly phosphorus, calcium and iron, and are not inferior to wheat in nutritive value. Further, the coarse types possess thicker bran layers, so that the loss of bran and bran constituents through milling is less in the case of the coloured and coarse varieties as compared with the loss sustained by the so called superior varieties. It is necessary, therefore, to educate people to consume the coarser rice.

4. Milling

We have seen how machine-milling very seriously reduces the nutritive value of rice, more especially of raw rice; and as in some parts of the country only raw rice is consumed, it is necessary to carry on vigorous propaganda against having the paddy taken to mills for husking and polishing. People should be induced to husk the paddy in

small quantities in the home on the flat wooden chakki described in Chapter II,[1] as this leaves the rice entirely unpolished. If slightly polished rice is desired it may be pounded in a dhenki. [2]

5. Do we need Rangoon rice ?

Quantitatively, if the enormity of loss involved in polishing rice, whether in the mills or by hand pounding is realised, all efforts would be directed towards stopping this unnecessary waste, especially so now, when there is a general shortage of food, particularly of rice, with the stoppage of rice from Burma. Along with the "Grow more food campaign" it will be well to insist on this aspect of the question. It is not enough to grow more. It is essential that whatever is grown is fully utilized and every form of waste avoided.

India's average yearly production of clean rice is about 30 million tons. About 1½ million tons are imported from Burma. If we do not take account of the small percentage of export, the import of Burma rice comes to only 5 per cent of the total Indian rice. We are disturbed at the loss of this 5 per cent because it is sudden and apparent, but we have chosen to be indifferent to over 10 per cent loss caused by polishing our rice. That means, the loss in polishing rice is easily twice as much as the import from Burma. What is more, the unpolished whole rice, being more nutritive, is consumed less than the less nutritive polished rice. Thus the saving effected in both these ways will amount to at least 15 per cent *i. e.* 4½ million tons. If we can save this wastage, and let us hope the urgency of the situation will enable us to save it, there is no cause to be perturbed by the loss of Burma rice.

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1. Pages 23-26
2. Pages 33 & 34

It is gratifying to note that the Government has advised the people to eat only hand pounded rice and thus eliminate the waste of foodstuff. We would only urge that the ambiguous term hand pounded, which implies varying degrees of polishings, should be replaced by the clear term 'whole unpolished rice' which alone can ensure the stoppage of waste.

6. Using rice polishings

Although wholly unpolished rice is best, still if people prefer to use only polished rice, it is necessary that they should consume a proportionate amount of rice polishings or bran. The embryo or germ area and the bran coat are collectively called bran and constitute the polishings.

COMPOSITION OF RICE BRAN [1]

	Per cent
1. Calcium, iron, phosphorus etc.	8.7
2. Proteins	19
3. Fat	20
4. Vitamins B_1 B_2 & E	...
5. Carbohydrates	43
6. Cellulose and fibre	1
7. Moisture	8.3

The presence of these valuable body-building materials in the bran is due to the fact that the embryo requires, at the time of germination, such type of food as can be readily converted into growing tissues.

The amount of bran to be consumed depends on the amount of polished rice eaten. As 11 parts of unpolished rice yield about 10 parts of polished rice and 1 part of rice

1. Leaflet No. 22 issued by the Bombay Presidency Baby & Health Week Association, B. D. D. Chawl, 10 Delisle Road, Bombay.

polishings, bran must be consumed in the ratio of 1 to 10 of polished rice. It begins to go bad within 4 or 5 days. But it can be preserved thus; "It should be heated cautiously over a low fire for about an hour, till it turns slightly dark in colour. In this way the moisture in the bran is removed and it is heated uniformly. The heating also stops the action of ferments in the bran and destroys any moulds, insects or other eggs that may be present in it. The bran thus remains sweet for at least a week and the vitamins and salts are scarcely affected." (*Philippine Journal of Science, September, 1939*).

The bran should be ground fine, if it is coarse, and used in cakes or curries. It makes the food richer and more palatable owing to the variety of salts and other minerals in it. The various ways of making use of bran in Indian diet have still to be experimented on and discovered. Dr. W. R Aykroyd, of the Nutrition Research Laboratories, Coonoor. mentions in a letter addressed to us, the following as prevailing in the villages of south India.

1 The polishings are mixed with a little jaggery (gur) and coconut. The mixture is kneaded well with a little water and consumed without cooking.

2. The same mixture may be kneaded and baked on an iron pan as thin chappati.

3. It may be fried in oil (or ghee, if this can be affor-ded) into small cakes, the size of an ordinary biscuit.

4. The mixture may be steamed and eaten as a pudding

It is essential that the bran used in the above preparations should be FINE. The proportions in which these are mixed ordinarily are :

		by weight
" Rice polishings	... ...	8.0
Jaggery (gur)	... ...	1.5
Coconut scrapings	... ...	2.5

These preparations are consumed by very poor people. Only the finest polishings are selected for such preparations."

Rice bran makes a good addition to wheat or ragi porridge when it is sprinkled on the porridge and eaten with it. It can be toasted and the powder used like coffee or cocoa for hot drink with milk. It can be mixed with the dough 30% while making chappaties or puries.

It will be well worthwhile to see if bran cannot be used in curries as well, and in the manufacture of sweets.

Preparation of rice bran extract.

600 c. c.s of water are brought to the boil and to it are added 30 grammes (20:1) of good quality rice bran, one gramme citric acid and stirred well. The mouth of the vessel is closed and left for 15 minutes. It is carefully filtered through a fine muslin. The filtrate (approx. 400 c. c) is again brought to the boil and to it is added 20 gms. of bran and extracted as before. To the filtrate (approx. 300 c. c), the juice from half a lime fruit and sugar are added to taste.

Requirement Approx. 900 c c (30 ozs) are required per day.
Keeping quality The above extract can be kept for 2 days at room temperature without spoilage

7. Supplementing the deficiencies of a Rice Diet.

There is no doubt that valuable as rice is as staple food, it fails by itself to provide all that a human being

requires to be in a fit state of health. It has, therefore, to be supplemented in various ways. The following extracts from 'Rice', Health Bulletin No. 28, published by the Manager of Publications, Delhi, 1940, give useful information in this regard.

"Let us compare the rice-eater's diet with a well balanced diet which is based on rice but contains a plenty of other foodstuffs as well. This is done in Table 6. The 'actual' diet is an average one based on the results of surveys in many parts of India. The 'well-balanced' diet closely resembles various diets which have been recommended by the Nutrition Research Laboratories, Coonoor.

TABLE 6.

The 'actual' diet of the rice-eater and a 'well-balanced' diet.

(Ozs. per adult man daily.)

Food	Actual	Well-Balanced Diet
Rice	... 15-25	15
Pulses	... 0.5-1.5	3
Milk	None or negligible amounts	8
Leafy vegetables ...	... 0.5-1.0	4
Non leafy vegetables	... 2.0-5.0	6
Fruit	... negligible	2
Vegetable fats and oils	... less than 1.0	2
Fish, meat and eggs	... 0.5-1.5	3 (when milk is absent from the diet or taken in negligible quantities.)

(With condiments and spices in small quantities.)

This at once gives us an idea of what to aim at in order to improve the poor rice-eater's diet. Let us discuss the question of supplements in greater detail.

(i) *Cereals*—The various millets and whole wheat have a higher food value than milled rice. It is, therefore, a good thing that some wheat or millet (say 4 to 6 ozs. daily) should be included in rice diets. The cultivation of wheat is limited by climatic conditions, but the millets are grown all over the country. Agricultural workers should give special attention to increasing the yields and extending the cultivation of these cereals. Unfortunately the millets (ragi or marua; cambu, or bajra; cholam, Italian millet, etc.) are often considered to be an inferior type of food. Nutrition research has shown that this idea is false.

(ii) *Pulses*—Most rice diets contain too little pulse. Pulses supply some of the vitamins and other essential dietary constituents in which rice is deficient. Since they are rich in the antiberi-beri vitamin, they are particularly valuable as a supplement, when the diet is based largely on the raw milled rice. Agricultural departments should aim at increasing the cultivation of pulses by developing improved varieties, etc.

(iii) *Milk*—In many parts of the country the poor rice-eater consumes no milk at all. We have already remarked that milk is the best supplement to rice diets. It follows that every effort should be made to increase the production of milk and milk products.

When whole milk is not available because it is too expensive or produced in insufficient quantities, milk reconstituted from skimmed milk powder can be recommended. This applies especially to children's homes. Butter-milk, unless excessively diluted, is a valuble addition to the poor rice-eater's diet.

Typical rice diets are deficient in calcium. This deficiency can be made good by milk. Other foods rich in calcium include ragi and leafy vegetables Calcium can also be provided in the form of a calcium salt-, *e. g.*, calcium lactate. About one gramme of calcium lactate daily, definitely improves the state of nutrition of children on a rice staple. The cost of this is only 1-2 annas per child per month.* Calcium lactate may be given regularly to school children as a *partial* milk substitute, and it may be strongly recommended for pregnant and nursing women.

(iv) *Vegetables*—Leafy vegetables, which are rich in provitamin A and calcium, are particularly valuble supplements to poor rice diets. Surveys have shown that intake is everywhere below the desirable level. The non-leafy vegetables are usually eaten in greater quantities, but the amount recommended in the well-balanced diet is seldom reached. A greater consumption of vegetables of any kind would improve standards of nutrition in India. On this point the Russel Report may be quoted:

> ' Much more work should be done on the cultivation of green leafy vegetables and demonstration fruit and vegetable gardens should be set up adjacent to the villages, where they can receive manure and water. A marked extention of vegetable growing is very desirable.'

We may lay special emphasis on the development of kitchen gardens in villages. This has been strongly recommended by the Nutrition Research Laboratories and is now part of the programme of Health Units, etc., working among village populations. In some places considerable

* At the pre-war price

success has been achieved. Normally the villager in many parts of India is not interested in growing vegetables even when land and water for this purpose are available. Education and propaganda are required to teach him the value of vegetables as food and to persuade him to grow these for his own use when circumstances permit. More attention might be given to vegetable growing by agricultural research workers and departments.

(v) *Fruits*—Not enough fruit is grown and eaten in India. Fruits are rich in various vitamins, particularly vitamin C, which prevents scurvy. The Indian gooseberry (Amla) is particularly rich in vitamin C. Certain fruits are a good source of vitamin A Mangoes, papayya, tomatoes and oranges are among the fruits which are of high nutritive value. Emphasis may be placed on the tomato, a cheap food of high nutritive quality, which is being successfully popularised in certain parts of India.

(vi) *Vegetable Oils and fats*—The rice eater's diet is normally very poor in fat and his intake is below the standards of fat intake usually recommended. His intake of vegetable fats and oils could, with advantage, be raised.

(vii) *Eggs, fish and meat*—Eggs are of high nutritive value, and an increase in production is to be recommended.

Meat, which in some respects makes a good supplement to rice diets, is eaten only in very small quantities or not at all in most parts of India. In the existing economic circumstances a material increase in supply is not very feasible."

Fish is a food of considerable value particularly as it is rich in calcium. A greater intake of fish would un-

questionably do something to improve standards of nutrition in India.

There are fish available in Indian waters, which might supply abundant liver oil of high vitamin potency; the liver oil of certain of these have, in fact, many times the potency of cod liver oil. One such is the shark liver oil[1] which is rich in vitamin A which is sorely lacking in rice. Red palm oil, obtained from the fruit of the tree Elaeis Guineensis grown extensively in West Africa and Malaya and lately introduced on an experimental scale into tropical India, has been successfully used as a substitute for cod liver oil in hospitals and dispensaries."

8. Storing and preserving unpolished rice

We have already pointed out that unpolished rice will not keep for long and is likely to be attacked by weevils. It is, therefore, advisable to store paddy and dehusk it from time to time in small quantities as and when required. Paddy will keep for more than a year when stored in properly constructed granaries. Unpolished rice, however, usually becomes rancid within two or three months or less. As a rule, however, in villages this defect is of minor importance as far as internal production and consumption are concerned, as ordinarily rice is not stored for more than a few months and villagers live from hand to mouth so far as their food supply is concerned. The keeping quality of rice is of importance chiefly in international trade and it may be an advantage that unpolished rice owing to its poor keeping qualities cannot be exported, as then it will be available for the people.

Unpolished rice can be preserved for a few months by smearing it with castor oil. This is the simplest and most

1. Shark liver oil can be had from the Government Oil Factory, Calicut.

effective method practised in some parts of the country. Half a pound (*i. e.* ¼ seer) of castor oil is mixed in a maund (40 seers) of rice.

Another effective method is to take cowdung 1lb. pure earth 1 lb. mercury 2 tolas, mix them together thoroughly and make tablets of 5 tolas each out of the mixture. These are then completely dried in the sun, 5 to 7 tablets are placed in each layer containing 1 maund of rice stored in earthen granaries.

Still another method is to mix turmeric with the rice. Ideal storing conditions of unpolished rice have to be investigated still further. It is hoped nutrition experts and the agriculture research workers in our country will give priority to tackle this problem in the near future.

2. THE STATE

As rice is the staple food of millions of our people, the State, in the sense of the Government and local bodies, can do a great deal to see that what is available for consumption by the people is not deprived of its food value. They can help effectively in the following ways.

1 Insisting on the use of unpolished rice in public institutions.

Government and local bodies can stop the use of polished, raw rice in spheres under their control, *e. g.*, in jails hospitals, college and school hostels, hotels and restaurants,

2 Charging a heavy license fee on rice mills

Local bodies have it in their power to refuse to grant licenses to rice mills, or to charge a prohibitive licensing fee and governments can issue orders to local bodies to restrict or refuse the granting of such licenses.

3 Levying a tax on milled rice

In the Philippine Islands, the Government has very effectively dealt with the problem of controlling or putting an end to the production and consumption of polished rice. It levies a **tax**[1] amounting to Rs. 8-12-6 per bag of 246 lbs. of milled rice. The tax is collected on each bag at the time of its removal from the rice mill, if the bag is not to be exported and the same amount of tax is levied also on polished rice imported into the country. It may not be necessary in our country to levy such a heavy tax on milled rice. The difference between the price of hand-pounded unpolished rice and milled rice is, at the most, only Rs. 1-8-0 per bag. So if our governments can give protection to hand-pounded rice even to this extent, the evil of highly polished mill rice can be effectively overcome

4. Abolishing rice mills

The final remedy, of course, is for the Government to ban rice mills and the import of polished rice altogether. A government which is entrusted with the welfare of the people will be guilty of a criminal breach of trust if it fails to take drastic measures when the food of millions of its people is being deliberately devitalised and impoverished

In this connection, the Government of Travancore State need to be congratulated on banning all the rice mills in the State and thus have set a bold example to other States and provincial governments to follow.

1 For details see Appendix B

APPENDIX A

POSTER MATERIAL IN REGARD TO RICE.

1. What is unpoished rice ?

Rice obtained by merely removing the outer husk of paddy is called unpolished rice. It is brown or reddish in colour. By constant rubbing, it loses this brown or reddish coating and becomes white, when it is said to be polished. White rice available in the market is highly polished.

But it is the outer covering of the grain, removed by polishing, which contains most of the mineral salts and vitamin value of rice. When it is removed in order to make the rice white, it leads to various diseases.

Use therefore only unpolished rice.

2. Losses due to polishing rice.

Through polishing the rice is deprived of its thin brown outer covering and of the embryo part of the grain. These two constitute nearly a sixth of the whole grain, and contain more than half its mineral matter, a fourth of its protiens, and pratically the whole of its vitamins and fat.

Not only is polishing wasteful, but also harmful, as owing to lack of the minerals and vitamins, the body fed on polished rice is starved of what it essentially needs and is unable to assimilate what is of value in other foods.

If you would save your money and your health do not use polished rice.

3. Loss through polishing rice

	VALUE	LOSS
Unpolished rice	100.0	nil
Once polished	45.0	55.0
Twice polished	25.0	75.0
Thrice polished *(as usually sold in the bazar)*	17.5	82.5

If you want full value for your money buy unpolished rice.

4. Loss of minerals by polishing rice

	RAW RICE Hand-pounded	Machine polished	Loss percent
Phosphorus content	0.28	0.13	54
Calcium content *(Bengal varieties)*	0.043	0.013	70
Iron content	2.2	1.0	55

Phosphorus is necessary for all living tissues and is an important constituent of blood.

Calcium is needed for the growth and well-being of the bones and teeth. It helps our bodies to use other constituents of food such as fats and iron.

Iron is required for blood formation and for the blood to remain in the healthy condition.

Do not deprive your body of these minerals which it sorely needs. Use only hand-pounded unpolished rice.

5. Loss of Vitamin B_1 through polishing rice

Vitamin B_1 is needed for the building and repair of the body.

1. It keeps the brain, the nerves, the heart, the liver, the digestive glands and the kidneys healthy and strong.

2. It enables the muscles of the body, including those of the bowels, to remain in a fit condition.

3. It maintains the appetite and aids digestion. When food contains plenty of Vitamin B1 it is not only eaten with relish but digested well, and waste materials are discarded properly from the body.

Absence of this vitamin causes beri-beri, a disease which attacks the nerves and heart and ultimately leads to heart-failure.

Vitamin B1 in unpolished raw rice	4.0
,, B1 in mill polished raw rice *(as sold in the bazar)*	0.7
Percentage of Vitamin B1 lost through mill polishing	82.5

Can you afford to use polished rice and starve your body of this most important ingredient of rice ?

6. Would you rather eat chaff than bread ?

Mill polished rice is worse than chaff, for it not only has no nutritive value but injures the system, leading to various diseases.

If you want to be healthy use hand-pounded unpolished rice.

7. Appearances are deceptive

White mill polished rice is alluring but has no nutritive value.

Unpolished rice is not white, but rich in Vitamin B1 which wards off beri-beri.

8. Do you suffer from constipation ?

Do not use pills and purgatives which gradually worsen the malady.

Use unpolished rice and whole meal handground flour.

9. Who is a fool ?

Only a fool will eat the husk and throw away the grain. This is what one does when one eats mill rice.

The elements of value in rice are in the germ and outer covering, both of which are absent in mill rice.

10. The digestibility of unpolished rice

It is sometimes thought that unpolished rice is difficult to digest. This is not so. Scientists assure us that the difference in digestibility between polished and unpolished rice is so small that it amounts in practice to zero. A system used to polished rice will soon adjust itself to unpolished rice without difficulty. Only, unpolished rice being richer must be taken in smaller quantities than polished rice.

Why eat devitalised, impoverished, polished rice, when one can as well eat the richer and more wholesome unpolished rice ?

11. Diseases from use of polished rice

Polished rice and white wheat flour contain neither enough building materials for the bones, teeth and tissues, nor enough builders (vitamins) to build them into the body. Those who eat polished rice and white wheat flour are liable, therefore, to suffer from diseases relating to the bones and teeth, the heart, the lungs and the kidney.

12. Vitamin A in rice

Vitamin A is needed for the growth and repair of the body, and especially to protect the body from infectious

diseases. Unpolished rice contains some but not much Vitamin A. What it does contain is removed when rice is milled and polished, or destroyed when it is parboiled.

Eat therefore unpolished rice.

13 Eat unpolished rice for Vitamin B1

If we take fresh paddy, husk it and give it with water as food to pigeons they will remain well. But if the paddy is sent to a rice mill where it is turned into white polished rice, and then it is given to pigeons they will lose weight, have no appetite, suffer from diarrhoea, get paralysed and die. The milling and polishing have removed from the rice something which is essential to the life and health of the birds. This something is Vitamin B1.

If you are eating mill polished rice remember the fate of the pigeons. Take to unpolished rice.

14. Parboiled rice

Parboiled rice is obtained from dehusking paddy which has been soaked in water for 48 or 72 hours, boiled for about 15 minutes and then dried in the sun for 13 days, and in the shade for 2 days.

In the process of boiling, much of the mineral salts and vitamins of the rice diffuse into the grain, and so cannot be rubbed off by polishing, as happens in the case of raw rice.

Parboiled polished rice is therefore preferable to raw polished rice.

If you must use polished rice, use parboiled polished rice.

15. Parboiled rice *vs.* Raw polished rice

	Parboiled rice	Raw polished rice
Phosphorus	.15	.11
Calcium	.01	.01
Iron	2.2	1.0
Vitamin B1	60	20

Do not use polished raw rice. If you want polished rice use parboiled rice.

16. Eat coarse rice

It has become the fashion to eat fine, white rice. Such rice is not only expensive, but it does not have as much nutritive value as the red and coarse varieties of rice usually spurned by the well-to-do. It has been found that most coloured rices contain more than two to three times the quantity of iron normally present in rice varieties.

Try coarse red rice. It has more taste than the fine white mill rice which is insipid.

17. Washing and cooking rice

Unpolished rice takes longer to cook than polished rice. So for a few hours before cooking, it should be soaked in water just enough for the purpose. This saves fuel.

Iron, phosphorus and Vitamin B_1 dissolve in water. So rice must not be washed much, nor should it be boiled except in just enough water, so that no water remains to be thrown away. Even if some water is left from cooking, it should be used in making other dishes, or drunk, and not discarded.

If rice is washed 3 times and cooked with liberal amounts of water, as is usually done, 75% of the iron, 50% of the phosphorus and 50% of Vitamin B_1 originally present may be lost.

Do not wash out these valuble ingredients, nor throw them away with the water used in cooking.

18. Composition and use of rice bran

The embryo or germ area and the thin coating of the husked grain are collectively called bran and constitute the

rice polishings which should be eaten if rice is consumed in the polished state.

Bran has the following valuable ingredients:

		Per cent
1.	Calcium. iron, phosphorus etc.	8.7
2.	Proteins	19
3.	Fat	20
4,	Vitamin B_1, B_2 and E	

As 11 parts of unpolished rice yield about 10 parts of polished rice and 1 part of polishings, bran must be consumed in the ratio of 1 to 10 of polished rice.

It should be eaten while still it is fresh. It can be stored for about a week if it is slightly roasted over fire.

It can be made into biscuits, or ground fine and with 15% gur (jaggery) and 5% coconut scrapings, kneaded and baked on an iron pan as a thick chappati, fried in oil in small cakes, or steamed and eaten as a pudding. It makes a good addition to wheat or ragi porridge when it is sprinkled on the porridge and eaten with it. It can be roasted and the powder used like coffee or cocoa for hot drink with milk. It can be mixed with the dough (30%) while making chappatis or puries. It may also be used in curries, or made into sweets.

Supplement your diet of polished rice with bran.

19. How to supplement rice diet ?

If your diet consists chiefly of rice or wheat, eat with it milk, milk products, green leafy vegetables and fruit. This will provide you with all the mineral salts you need in the right proportion.

Too little mineral salts in the food leads to rickets, weak and soft bones, bad teeth, wasting anaemia, lassitude, poor appetite, bad digestion, constipation, goitre and acidity of the blood.

20. Supplementing rice diet for Vitamin A

Lack of Vitamin A leads to stunted growth, blindness, pneumonia, tuberculosis, diarrhoea, dysentry, dropsy, and stone-in-the-bladder.

Rice does not contain much of this vitamin. So it should be supplemented by milk, butter or ghee, and green leafy vegetables, as plenty of this vitamin is found in them. Liver, eggs and fish oils also are rich in Vitamin A.

21. To make up calcium deficiency in rice diet.

Calcium is needed for the building of the bones and teeth, to make the heart work properly, to make the blood clot so that too much blood is not lost if our bodies are cut or wounded, and to help our bodies to use properly certain other constituents of food, such as fats and iron. If your food contains enough milk, buttermilk, nuts, dals, fruits and green leafy vegetables, you will get all the calcium you need

22. Green leaves for mineral salts deficiency in rice

Mineral salts form about 1/25th part of the whole body. They prevent the blood, the tissues, and body-fluids from becoming sour or acid. If the blood becomes even a little acid we get ill, and if more acid we die.

Mineral salts help the heart to beat. Without them there will not be enough water in the tissues, the kidneys will not act properly, the waste products of the body will not be cleared, nor will the stomach and other organs of digestion produce the necessary digestive secretions.

Eat green leaves. They are rich in just the mineral salts in which rice is poor.

23. Alkali supplements for rice diet,

Green leafy vegetables, tuber and root vegetables, and fruits are rich in alkali producing elements, while rice and pulses are rich in acid producing elements. So those who eat much rice must eat especially plenty of leafy vegetables.

24. Sprouted grain for Vitamin C deficiency in rice

Lack of Vitamin C leads to scurvy or bleeding of gums. This vitamin keeps the bones, teeth and bowels healthy, and it helps the body to resist infection by microbes.

As rice is lacking in this vitamin, it is necessary to obtain it from other sources. It occurs plentifully in all fresh green vegetables, in edible green leaves and in most fresh fruits. It is easily destroyed by heat, and therefore does not survive cooking.

A good way to obtain Vitamin C, when green vegetables and fresh fruit are scarce, is to moisten grains in water and allow them to sprout. The sprouted grains should be eaten raw or after cooking for not more than two minutes.

25. Dal with rice

Pulses are a good source of Vitamin B and should be eaten with rice. The amount of dal to use with rice is about one part of dal to five or six parts of rice. But not more than 4 to 5 oz. of dal should be eaten a day, as more goes bad in the bowels.

26. Vegetables with rice

Those who grow rice for their own use should always keep a small plot of land for growing tomatoes, pulses groundnuts and green leafy vegetables. The best of all to eat with rice are tomatoes.

27. A well-balanced rice diet

(In ozs. per adult man per day)

Food	Actual Diet	Well-Balanced Diet
Rice	15-25	15
Pulses	0.5-1.5	3
Milk	None or negligible amounts	8
Leafy vegetables	0.5-1.0	4
Non-leafy vegetables	2.0-5.0	6
Fruit	negligible	2
Vegetable fats and oils	Less than 1.0	2
Fish, meat and eggs (with condiments and spices in small quantities)	0.5-1.5	3 (when milk is absent from the diet or taken in negligible quantities)

28. Chakki for paddy-husking

Do not by any means take your paddy to the rice mills for husking. Machine-milling takes away from the rice most of its minerals and all its vitamin content.

The best way of removing the husk from the grain is to use a flat, grooved, wooden chakki. It can be had from the A. I. V. I. A., Wardha, for Rs. 12-8-0, freight extra. Or you may obtain a small wooden model of it also from the A. I. V. I. A., Wardha for Rs. 1-8-0 and make a full sized chakki for yourself.

The capacity of this chakki is 4 or 5 maunds of paddy in an eight hour day, and breakage of grain about 5%. Such a chakki produces wholly unpolished rice. As unpolished rice does not keep for a long time, small quantities of paddy should be husked in the home from time to time as and when required.

29. To preserve unpolished rice

As unpolished rice does not keep for long, one of the following methods may be adopted to preserve it.

1. Smear ¼ seer of castor oil on 40 seers of rice.
2. Take cowdung 1 lb., pure earth 1 lb., mercury 2 tolas, mix together thoroughly and make tablets of 2 tolas each out of the mixture. Dry the tablets in the sun. Place 5 to 7 tablets in each layer containing 1 maund (40 seers) of rice stored in earthen granaries
3. Mix turmeric with the rice.

30. Unemployment created by rice mills

	Place	Metohd	Amount of Paddy treated (in mds.)	No. of persons employed	Persons that can be employed if rice is home-pounded
1.	Bulsar (*Gujarat*)	Home-pounding	3½	5	5
2.	Bardoli (*Gujarat*)	Rice Mill	105	5	150
3.	Tumsar (*C. P.*)	,,	208	14	400
4.	Guntur (*Andhra*)	,,	360	40	515

As the size of the mill increases, its capacity to displace persons also increases.

31. Rice mill is not a national gain

It satisfies the greed of a few by depriving many of a means of supplementing their income by a spare time occupation.

It devitalises a staple article of food on which millions solely depend for their sustenance.

32. Consumption of hand pounded rice

Province	Percentage of rice eating population using hand-pounded rice (1938)
1. Bihar	90
2. Assam	85
3. United Provinces	85
4. Orissa	80
5. Bengal	75
6. Hyderabad	70
7. Travancore	45
8. Madras	30
9. Burma	20

33. Cost of hand-pounding *vs.* machine-milling

(To prepare 2½ mds. of rice

	Unpolished	Polished
In mill	0-6-0	0- 8-0
By hand-pounding	0-6-0	0-15-9 Once polished 1- 5-0 Twice polished

1. The cost of preparing unpolished rice is the same in either method.
2. If unpolished rice is used because of its superior nutritive value, rice mills will have to close down as they cannot meet their overhead charges in competition with hand-pounding.

3. Reduce the degree of polishing to lower the cost of hand-pounding and at the same time you will have increased the nutritive value of the rice.

34. Consumption of hand-pounded *vs.* machine-milled rice

1. Preparing a maund of rice by hand-pounding costs 2½ to 4½ annas more than by machine-milling.
2. An average family in a rice eating tract eats about 2 maunds of rice per month.

3 Hand-pounded rice, therefore, costs from 5 to 9 annas more per month per family.

4. But it repays in the form of richer food values.
5. And if prepared at home in spare time it will cost nothing.

6. On the other hand the exercise involved will increase one's health and strength.

APPENDIX B

AN ACT

Imposing an internal revenue tax on polished rice manufactured in or imported into the Philippine Islands

By authority of the United States, be it enacted by the Philippine Legislature, that:

Section 1—Polished rice, for the purposes of this Act, shall embrace every kind of rice from which the pericarp and sub-cortical, or other layers have been removed, and which shows upon analysis less than four-tenths of one per cent of Phosphorus pentoxide (P_2O_5).

Section 2—There shall be levied, collected, and paid, on all polished rice within the Philippine Islands, at the time of its removal from the building or establishment where the opera - tion of polishing is performed, an Internal Revenue tax at the rates of five centavos on each kilogram: PROVIDED, that the tax imposed in this section shall not be collected on rice poli- shed in the Philippine Islands and withdrawn from the build- ing or establishment wherein it was polished for export to any point outside of the Philippine Islands, if such rice is actu- ally so exported, and proof of such exportation submitted to the Collector of Internal Revenue in such form and within such time as he may by regulation prescribe.

Section 3—There shall be levied, collected, and paid upon all polished rice imported into the Philippine Islands, from the United States or foreign countries, in addition to the import duties imposed (if any), an Internal Revenue tax at the rate

of five centavos per kilogram. This tax shall be paid to the Collector of Internal Revenue, or his duly authorized representative, by the owner or importer of such rice, while the same is in the custody of the proper Customs Officer; and such rice shall not pass out of the custody of said Customs Officer until the tax shall have been so paid-

Section 4—All the provisions of Act Numbered Eleven Hundred and Eighty-nine, entitled "The Internal Revenue Law of 1904", as amended, regarding the time and manner of collection, and manner of accounting for the specific tax imposed by the provisions of said Act on distilled spirits, fermented liquors, and tobacco products, and all the provisions of said Act, and the regulations issued thereunder, applicable to manufacturers of such articles, shall apply to importers and manufacturers of polished rice.

Section 5—The Collector of Internal Revenue shall issue such rules and regulations as may be necessary to carry into effect the provisions of this Act, and are not in conflict therewith; and such regulations, when approved by the Secretary of Finance and Justice, shall have the force and effect of law.

Section 6—Any person violating any of the provisions of this Act, or of any lawful regulation issued thereunder, shall be punished by a fine of not less than one hundred pesos, nor more than thousand pesos, or by imprisonment for a period of not less than one month, nor more than five years, or by both such fine and imprisonment, in the discretion of the Court.

Section 7—The collector of Internal Revenue, with the approval of the Secretary of Finance and Justice, may compromise any civil or other case arising under the provisions of this section, instead of commencing or prosecuting suit thereon, and with the consent of the Secretary of Finance and Justice, he may conpromise such case, if action has been begun thereon.

APPENDIX C

NUTRITIVE VALUE OF INDIAN ARTICLES OF FOOD

In the following Table of Food Values taken from Health Bulletin No. 23 of the Government of India, but re-arranged as seemed most suited to our requirements,

1. The figures under Vitamins indicate International units per 100 gms.

2. Calories are heat units by which food requirements are estimated. The following is a practical scale of Calorie requirements.

Co-efficient here means the proportion of food required by others as compared with an adult male. who is taken as requiring a unit.

	CO-EFFICIENT	CALORIES REQUIRED
Adult male (over 14)	1.0	2600
Adult female (over 14)	0.8	2100
Child 12 & 13 years	0.8	2100
Child 10 & 11 years	0.7	1800
Child 8 & 9 years	0.6	1600
Child 6 & 7 years	0.5	1300
Child 4 & 5 years	0.4	1000

3. The composition of a 'well balanced' diet is roughly as follows :

Protein	73 gms.
Fat	74 gms.

Carbohydrates	408	gms.
Calories	2590	
Calcium	1.02	gms.
Phosphorus	1.47	gms.
Iron	44.00	mgs.
Vitamin B_1 (International Units)	over 7000	
Vitamin A (International Units)	over 400	
Vitamin C	about 170.0	mgs.

4. 'Extra' requirements of women during the latter months of pregnancy and lactation may be very roughly indicated as follows :—

Food Factor	Percentage Increase In Requirements
Calories	25
Protein	50
Fat	10
Calcium	100
Phosphorus	50
Iron	50

5. We have thought it well to give also biological value of protein content of food, as what is of practical value is not so much how much protein a grain contains, as how much of this is assimilable by us, which is what biological value means.

6.

100 Gms.	=	3.5 Ounces-
100 Gms.	=	8.75 Tolas
1 Ounce	=	28.4 Grammes
1 Chhatak = 2 Ozs.	=	56.8 Grammes
1 Tola	=	11.4 Grammes
1 Seer = 2 lbs.	=	907.2 Grammes

1 Gm.	=	1,000 Milligrams (mg.)
1 Gm.	=	1,000,000 Micrograms. (mic. g)
1 International Unit	=	1 Microgramme.

7. As no International Unit has yet been established for Vitamin B2 the method of indicating values by the following signs has been adopted :— + + + = very rich source, + + = a good source, + = the presence of the vitamin but not in large amounts.

Absence of figures means that tests have not yet been carried out.

Figures underlined indicate that the ingredient is the chief valuable feature of the article.

TABLE OF FOOD VALUES

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A	B1	B2	C	Remarks
Cereals														
Wheat, whole	Gehum	11.8	7.70	1.5	71.2	0.05	0.32	5.3	346	108	180	+	...	
Refined Wheat Flour	Maida	11.0	...	0.9	74.1	0.02	0.09	1.0	349	...	40	...	...	
'Bajra'	Bajra	11.6	9.60	5.0	67.1	0.05	0.35	8.8	360	220	110	Poor	...	
Cholam	Juar	10.4	8.63	1.9	74.0	0.03	0.28	6.2	355	136	115	Poor	...	
Barley	Jau	11.5	8.16	1.3	69.3	0.03	0.23	3.7	335	...	150	Poor	...	
Oatmeal	Jai	13.6	8.84	7.6	62.8	0.05	0.38	3.8	374	Trace	325	...	...	
'Kootu'	Kootu	10.3	---	2.4	65.0	0.07	0.30	13.2	323	...	300	...	...	
Maize	Makai	11.1	6.66	3.6	66.2	0.01	0.33	2.1	342	...	...	...	...	
Ragi	Mundal or Okra	7.1	6 31	1.3	76.3	0.33	0.27	5.4	345	70	140	Poor	...	
Rice. raw, home pounded	Hath-kuta-chawal	8.5	6.80	0.6	78.0	0.01	0.17	2.8	351	4	60	Poor	...	

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosporus %	Iron Mgs. %	Calorific value	VITAMINS A.	B1	B2	C.	Remarks
Cereals *(Contd.)*														
Rice, parboiled, homepounded	Usna, Hath kuta chawal	8.5	6.80	0.6	77.4	0.01	0.28	2.8	349	15	90	...	...	
Rice, raw, milled	Mill-kuta chawal	6.9	5.52	0.4	79.2	0.01	0.11	1.0	348	0	20	Poor	...	
Rice, parboiled milled	Usna mill-kuta chawal	6.4	5.12	0.4	79.1	0.01	0.15	2.2	346	0	70	Poor	...	
Rice, beaten	Poha	6.6	5.28	1.2	78.2	0.02	0.22	8.0	350	...	70	Poor	...	
Rice, puffed	Mur-Mura	7.5	6.00	0.1	74.3	0.02	0.16	6.2	328	...	70	Poor	...	
Samai	Kutki	7.7	...	4.7	63.7	0.02	0.36	7.1	328	Trace	100	Poor	...	
Kodu millet	Kodan or Kodra	8.3	...	1.4	65.6	0.04	0.24	5-2	308	Trace	110	...	...	
'Singarah'	Singarah	13.4	...	0.8	68.9	0.07	0.44	2.4	336	Trace	...	...	...	
Pulses														
Bengal Gram (with outerhusk)	Chana	17.1	13.00	5.3	61.2	0.19	0.24	9.8	361	316	100	++	...	

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A	B₁	B₂	C.	Remarks
Pulses														
Bengal Gram roasted	Bhuna chana	22.5	17.10	5.2	58.9	0.07	0.31	8.9	372	...	...	...	...	without outer husk
Black Gram	Urd	24.0	15.36	1.4	60.3	0.20	0.37	9.8	350	64	140	+ +	...	without outer husk
Field bean dry	Val	24.9	18.00	0.8	60.1	0.06	0.45	2.0	347	Trace	...	none	...	
Green Gram	Mung	24.0	12.24	1.3	56.6	0.14	0.28	8.4	334	158	155	+ +	...	with outer husk
Lentil	Masur	25.1	10.29	0.7	59.7	0.13	0.25	2.0	346	450	150	+		
Peas	Mattar	19.7	...	1.1	56.6	0.07	0.30	4.4	315	..	150	...	...	
Red Gram	Arhar	22.3	16.54	1.7	57.2	0.14	0.26	8.8	333	220	150	+ +	...	without outer husk
Soya Bean	Soya Bean	43.2	23.32	19.5	20.9	0.24	0.69	11.5	432	710	300	+ +	...	„
Leafy Vegetables														
Amaranth	Choalai	4.9	3.60	0.5	5.7	0.50	0.10	21.4	47	2500 to 11,000	10	+	173	

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A.	B1	B2	C.	Remarks
Leafy Vegetables														
Cabbage	Band Gobhi	1.8	1.40	0.1	6.3	0.03	0.05	0.8	33	2000	50	...	124	
Celery	Ajwan kapatta	6.0	...	0.6	8.6	0.23	0.14	6.3	64	5800 to 7500	Trace	...	62	
Coriander	Dhania	3.3	...	0.6	6.5	0.14	0.06	10.0	45	10460 to 12600	...	+ +	135	
Curry leaves	Gandhela	6.1	...	1.0	16.0	0.81	0.06	3.1	97	12600	...	+ +	4	
Drumstick	Saijan	6.7	2.75	1.7	13 4	0.44	0.07	7.0	96	11300	70	...	220	
Fenugreek	Methi	4.9	...	0.9	9.8	0.47	0.05	16.9	67	3800	70	...	...	
Lettuce	Salad	2.1	...	0.3	3.0	0.05	0.03	2.4	23	2200	90	...	15	
Mint	Paudina	4.8	...	0.6	8.0	0.20	0.08	15.6	57	2700	...	...	...	
Neem, tender	Neem-patti	11.6	...	3.0	21.2	0.13	0.19	25.3	158	4600	...	...	...	
Spinach	Palak	1.9	...	0.9	4.0	0.06	0.01	5.0	32	2600 to 3500	70	...	48	

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A	B$_1$	B$_2$	C.	Remarks
					Roots & Tubers									
Carrot	Gajar	0.9	...	0.1	10.7	0.08	0.03	1 5	47	2000 to 4300	60	...	3	
Onion, small	Pyaz (chhote)	1 8	...	0.1	13.2	0 04	0.06	1.2	61	25	40	...	11	
Potato	Alu	1.6	1.07	0.1	22.9	.01	0.03	0 7	99	40	20	+ +	17	
Radish (white)	Muli	0.7	...	0 1	4.2	0.05	0.03	0.4	21	3	60	...	15	
Sweet Potato	Shakar-kand	1.2	0.86	0.3	31.0	0.02	0.05	0.8	132	10	...	+ +	24	
Tapioca	Maravali or Simla alu	0.7	...	0.2	38.7	0.05	0.04	0.9	159	0	15	...	...	
Yam (ordinary)	Ratalu	1.4	...	0.1	27.0	0.06	0.02	1.3	115	...	24	...	Trace	
					Other Vegetables									
Ash Gourd	Petha	0 4	...	0.1	3 2	0.03	0.02	0.5	15	Trace	21	...	1	
Bitter Gourd	Karela	1.6	0.2	0.2	4.2	0.02	0.07	2 2	25 }	210	24	Poor	88	
,, (small)	,,	2.9	...	1.0	9.8	0.05	0.14	9.4	60 }					

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A.	B1	B2	C.	Remarks
Other Vegetables														
Brinjal	Baingan	1.3	0.92	0.3	6.4	0.02	0.06	1.3	34	5	15	+	23	
Calabash	Lowki	0.2	...	0.1	2.9	0.02	0.01	0.7	13	Trace	...	...	...	
Cauliflower	Phool Gobhi	3.5	...	0.4	5.3	0.03	0.06	1.3	39	38	110	...	66	
Cluster beans	Guar ki phali	3.7	1.88	0.2	9.9	0.13	0.05	5.8	56	330	...	...	49	
Cucumber	Kakri	0.4	...	0.1	2.8	0.01	0.03	1.5	14	Trace	30	...	7	
Double beans	Chastang	8.3	...	0.3	12.3	0.04	0.14	2.3	85	...	...	...	22	seeds only
Drumstick	Saijan	2.5	...	0.1	3.7	0.03	0.11	5.3	26	184	...	...	120	
Ladies fingers	Bhindi	2.2	1.8	0.2	7.7	0.09	0.08	1.5	41	58	21	+	16	
Plantain green	Kele kocha	1.4	...	0.2	14.7	0.01	0.03	0.6	66	50	15	++	24	
Pumpkin	Kaddu	1.4	...	0.1	5.3	0.01	0.03	0.7	28	84	200	...	2	
Ridge gourd	Torai	0.5	...	0.1	3.7	0.04	0.04	1.6	18	56	22	...	...	
Snake gourd	Chachinda	0.5	...	0.3	4.4	0.05	0.02	1.3	22	160	...	...	Trace	
'Sundakai'		8.3	...	1.7	55.0	0.37	0.18	22.2	269	750	...	...	0	
Tomato, green	Tomator kacha	1.9	...	0.1	4.5	0.02	0.04	2.4	27	820	23	...	31	

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A	B1	B2	C	Remarks
Nuts & Oil Seeds														
Almond	Badam	20.8	...	58.9	10.5	0.23	0.49	3.5	655	Trace	80	...	0	
Cashewnut	Kaju	21.2	15.86	46.9	22.3	0.05	0.45	5.0	596	100	...	+	0	
Cocoanut	Nariyal	4.5	2 61	41.6	13.0	0.01	0.24	1.7	444	Trace	15	Poor	1	
Gingelly	Til	18.3	12.26	43.3	25.2	1.45	0.57	10.5	564	100	...	...	0	
Groundnut	Mung-phali	26.7	15 48	40.1	20.3	0.05	0.39	1.6	549	63	300	+	0	
Walnut	Akhrot	15.6	...	64.5	11.0	0.10	0.38	4 8	687	10	150	...	0	
Spices & Condiments														
Asafoetida	Hing	4 0	...	1.1	67.8	0.69	0.05	22.2	297	...	...	...	0	
Cardmom	Elaychi	10.2	...	2.2	42.1	0 13	0.16	5.0	229	...	...	...	0	
Chillies,green	Mirch-hari	2.9	...	0.6	6.1	0.03	0.08	1.2	41	454	...	...	111	
Chillies, dry	Lal Mirchi	15.9	...	6.2	31.6	0.16	0.37	2.3	246	576	...	...	50	
Cloves	Laung	5.2	...	8.9	47.9	0.74	0.10	4.9	293	...	...	...	0	
Coriander	Dhania	14.1	...	16.1	21.6	0.63	0 37	17.9	288	1570	...	...	Trace	

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A	B₁	B₂	C.	Remarks
							pices & Condiments							
Cumin	Zira	18.7	...	15.0	36.6	1.08	0.49	31.0	356	870	...	...	3	
Fenugreek	Methi	26.2	...	5.8	44.1	0.16	0.37	14.1	333	160	...	...	0	seeds
Garlic	Lehsun	6.3	...	0.1	29.0	0.03	0.31	1.3	142	0	...	...	13	
Ginger	Adrak	2.3	...	0.9	12.3	0.02	0.06	2.6	67	67	...	...	6	
Pepper	Kali Mirch	11.5	...	6.8	49.5	0.46	0.20	16 8	305	...	...	...	...	
Tamarind pulp	Imli	3.1	...	0.1	67.4	0.17	0.11	10.9	283	100	...	...	3	
Turmeric	Haldi	6.3	...	5.1	69.4	0.15	0.28	18.6	349	50	...	...	0	
						Fruits								
Apple	Seb	0.3	...	0.1	13.4	0.01	00.2	1.7	56	Trace	40	...	2	
Banana	Kela	1.3	...	0.2	36.4	0.01	0.05	0.4	153	Trace	50	...	1	
Dates	Khajur	3.0	...	0.2	67.3	0.07	0.08	10.6	283	600	30	+	Trace	
Figs	Anjeer	1.3	...	0.2	17.1	0.06	0.03	1.2	75	270	...	...	2	
Grapes	Angur	0.8	...	0,1	10.2	0.03	0.02	0.4	45	15	Trace	...	3	
Guava	Amrud	1,5	...	0.2	14,5	0,01	0.04	1.0	66	Trace	...	...	299	

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A.	B1	B2	C.	Remarks
Fruits														
Jack Fruit	Kat hal	1.9	...	0.1	18.9	0.02	0.03	0.5	84	540	...	...	10	
Jambu fruit	Jaman	0.7	...	0.1	19.7	0.02	0.01	1.0	83	...	...	...	...	
Lime	Nimboo	1.5	...	1.0	10.9	0.09	0.02	0.3	59	26	...	...	63	
Mango (ripe)	Am	0.6	...	0.1	11.8	0.01	0.02	0.3	50	4800	...	Poor	13	
Melon, water	Tarbuz	0.1	...	0.2	3.8	0.01	0.01	0.2	17	Trace	...	...	1	
Orange	Narangi	0.9	...	0.3	10.6	0.05	0.02	0.1	49	350	40	...	68	
Papaya(ripe)	Papita	0.5	...	0.1	9.5	0.01	0.01	0.4	40	2020	...	...	46	
Pears	Naspati	0.2	...	0.1	11.5	0.01	0.01	0.7	47	14	...	...	Trace	
Pineapple	Ananas	0.6	...	0	12.0	0.02	0.01	0.9	50	60	...	...	63	
Plums (red)	Zardalu	0.7	...	0.2	8.9	0.02	0.02	0.5	40	230	40	...	1	
Pomegranate	Anar	1.6	...	0.1	14.6	0.01	0.07	0.3	65	0	...	...	16	
Tomato (ripe)	Tomato	1.0	...	0.1	3.9	0.01	0.02	0.1	21	320	40	...	32	
Zizyphus	Ber	0.8	...	0.1	12.8	0.03	0.03	0.8	55	70	...	...	...	
Milk & Milk Products														
Milk, Cow's	Gai-ka dudh	3.3	2.80	3.6	4.8	0.12	0.09	0.2	65	180	...	++	...	

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A	B1	B2	C	Remarks
Milk & Milk Products														
Milk, buffalow's	Bhains-ka-dudh	4.3	3.65	8.8	5.1	0.21	0.13	0.2	117	162	...	...	...	
Milk, goat's	Bakri-ka-dudh	3.7	3.15	5.6	4.7	0.17	0.12	0.3	84	182	...	...	...	
Milk, human	stri-ka dudh	1.0	...	3.9	7.0	0.02	0.01	0.2	67	208	...	...	...	
Curds	Dahi	2.9	...	2.9	3.3	0.12	0.03	0.8	15	130	++	++	...	
Buttermilk	Chhaz	0.8	...	1.1	0.5	0.03	0.09	0.3	51	Trace	...	++	...	
Skimmed milk		2.5	...	0.1	4.6	0.12	0.09	1.2	29	...	...	...	...	
„ „ (powdered)		38.0	...	0.1	51.0	1.37	1.00	1.4	357	0	165+	++	...	
Cheese	Panir	24.1	...	25.1	6.3	0.79	0.52	2.1	348	273	...	...	...	
Flesh Foods														
Beef	Gai-ka-gosht	22.6	...	2.6	...	0.01	0.19	0.8	114	59	50	++	...	
Egg, fowl	Anda	13.3	...	13.3	...	0.06	0.27	2.1	173	1200	...	...	...	(Carotene units per 100 gms. is 1000)
Fish	Machhi	21.5	...	1.6	...	0.06	0.41	2.3	100	26	...	Poor	...	
Liver, sheep	Kaleja	19.3	...	7.5	1.4	0.01	0.38	6.3	150	22300	120	...	...	

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A.	B₁	B₂	C.	Remarks
Flesh Foods														
Mutton	Bakri-ka-gosht	18.5	...	13.3	...	0.15	0.15	2.5	194	30.8	60	...	...	
Pork	Suar-ka gosht	18.7	...	4.4	...	0.03	0.20	2.3	114	Trace	320	...	...	
Miscellaneous														
Arecanut	Supari	4.9	...	4.4	47.2	0.05	0.13	1.5	248	0	...	...	...	
Betel nut (Kalipakku)	Supari	6.4	...	8.4	57.8	0.13	0.14	11.1	332	0	...	...	...	
Betel leaves	Pan	3.1	...	0.8	6.1	0.23	0.04	5.7	44	0	...	...	5	(Cartotene units per 100 gms. 9600)
Cod liver oil	Machhli-ka tel	...	...	100.0	...	...	...	...	900.0	60,000 to 200,000	...	...	0	
Halibut liver oil	Machhli ka-tel	...	...	100.0	...	...	...	...	900.0	3,900,000	...	...	...	

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A	B1	B2	C	Remarks
*** Animal Fats**														
Mutton Fat		1.19		92.40	...				836.5	++	...	...	...	
Butter & Ghee	Makhan & ghee			80.85					728.0	+++	...	...	...	
*** Vegetable Oils**														
Cocoanut oil	Copraka Tel	...		98.0	...				882	+	O		O	
Gingelly oil	Tilka Tel	...		98.0	...				882	V.L	O		O	
Linseed oil	Alsika Tel	...		98.0	...				882	VL	O		O	
Groundnut oil	Mungfallika Tel	...		98.0	...				882	V.L	O		O	
Olive oil		...		98.0	...				882	V.L	O		O	
Cotton Seed oil	Binaolaka Tel	...		98.0	...				882	V.L	O		O	
Mustard oil	Sarsoonka Tel	...		98.0	...				882	O	O		O	
Cocogem		...		98.0	...				882	O	O		O	
Margarine		...		83.0	...				749	O to+	O		O	

Name of Foodstuff	Hindi Name	Protein Content % Biological value of protein content %	Fat %	Carbohydrate %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value	VITAMINS A.	B_1	B_2	C.	Remarks
					* **Sugar & Starches**								
White Sugar	Chini	...		...	99.05			395.5	O	O		O	
Brown Sugar	Bhura	...		...	94.12			378	O	O		O	
Jaggery	Gur	0.28		...	87.5			350	O	V.L		O	
Honey	Shahad	0.39		...	70.74			283.5	V.L	V.L		O	
Sugar Cane	Gunna	1.47	.	0.56	21.70			98	...	+		+	

V. L. = Very little.   * Adopted from SIR ROBERT McCARRISON'S "Food"

APPENDIX D

VITAMINS -- THEIR PROPERTIES & WHERE FOUND

The following is taken mainly from "A Survey of Present Knowledge", 1932—Medical Research Council Great Britain, reproduced in pamphlet No. 6 of the Bombay Presidency Baby & Health Week Association, B. D. D. Chawl, 10 De Lisle Road, Bombay No. 11. Slight changes have been made by us to make technical terms intelligible to the lay reader

Specially noteworthy points are indicated by heavy type.

Vitamin	Special action	Ill effects of the deficiency of the Vitamin	Properties	Distribution in nature
A	1. **Anti-infective :** Local defence of the mucus membranes of :—	1. Produces keratinization (or forming a horny matter of the upper layer of the skin)	1. Fat soluble	**Liver of sheep** milk, fish meal, fish oils
	a. Intestines	2. A factor in the causation of anaemia	2. Destroyed by aeration at all temperatures but not by closed heating up to 120°C for half an hour.	Butter Outer leaves of lettuce and cabbage, spinach, yellow carrots, tomato, bananas papaya, mango
	b. Eyes	3. Xerophthalmia (drying of the eye)		

Vitamin	Special action	Ill effects of the deficiency of the Vitamin	Properties	Distribution in nature
	c. Respiratory passage	4. Night blindness	3. Destroyed by exposure to light	Outer portion of orange peel, green tops of bamboo, radish and turnips
	d. Genito-urinary passage	5. **Susceptibility to infection**	Relation of Carotene to Vitamin A:- Carotene is found in plants (orange red colour). The same is stored in animals as Vitamin A (colourless)	(**Green spinach and green cabbage are weight for weight as good as best butter in their richness in Vitamin A**)
	2. Protects central nervous system			
	3. Promotes growth			Grams (germinated)
				Yellow maize
B_1	Necessary for growth and maintenance	1. Polynueritis : (inflammation of many nerves at a time)	1. Water soluble	It is found in yeast, whole grains and cereals, cabbage lettuce, potatoes, carrots.

Vitamin	Special action	Ill effects of the deficiency of the Vitamin	Properties	Distribution in nature
	Antineuritic	2. Beri-Beri : (see Chapter 1 above under Vitamin B_1	2. Stable at 100°C for half an hour (Baking of bread and biscuits does not destroy it).	yolk of egg, meat, brain of sheep.
		3. Loss of appetite	3. Is not found in preserved and canned foods.	Relative potency taking that of wheat germ as 100: **Rice germ = 200** Lentils = 80 Yeast = 60 Peas = 40
		4. A factor in the causation of anaemia	4. **Alkalies (Baking powders) destroy it readily.**	
		5. General tissue atrophy; less secretion of milk	5. Desiccation or exposure to air does not destroy it.	

Vitamin	Special action	Ill effects of the deficiency of the Vitamin	Properties	Distribution in nature
B^2	**Antidermatitic**	1. Pellagra (deficiency diseases of the skin)	1. Water soluble 2. More stable to heat than B_1 Other properties same as B_1	Practically the same as B_1 It is also present in yeast, spinach, peas, water cress, fruit. Liver, fresh cow's milk, white of egg.
C	**Antiscorbutic**	1. Scurvy (spongy & bleeding gums etc.) 2. General atrophy of tissues 3. Osteoporosis (softening) in bones and teeth	1. Water soluble 2. **Is produced during germination of seeds.** Is found in living plant tissues where active metabolic processes are still proceeding (green leaves & fruits).	all the green salad foods. Lemon juice, orange juice, tomato, papaya, cabbage. 'Amla'-cashew fruit.

Vitamin	Special action	Ill effects of the deficiency of the Vitamin	Properties	Distribution in nature
C			3. Very sensitive to oxidizing agents	Mung, Peas, Lentils } germinated
			4. Destroyed by alkaline medium in the presence of air (Baking powder)	
			5. Heating to 80°C or	Raw milk
			6. Drying in the sun destroys it	Meat
D	**Calcifying Vitamin** 1. Helps to assimilate Calcium and Phosphorus and thus to strengthen bones and teeth.		1. Fast soluble 2. It gives best results when a tolerably good supply of minerals is available in foods and less starchy foods are given.	Cod liver oil, butter, eggs, leafy vegetables Tomatoes, yellow carrots, milk, germ of wheat and maize.

Vitamin	Special action	Ill effects of the deficiency of the Vitamin	Properties	Distribution in nature
	2. Prevents diseases due to deficiency of Calcium.	1. Rickets 2 Osteomalacia; (rickets of grown ups) 3 Defective teething 4 Infantile Tetany (fits) 5. Tendency to haemorrhage (bleeding)	3. Is required more during periods of strain such as growth, pregnancy and lactation. 4. Crystalline Vitamin D (Calciferol) is very stable	**Sun-shine**
E	Neccessary for the synthesis of the Anterior Pituitary Hormone	1 One cause of sterility in males and females 2. Tendency to miscarriages	1. Fat soluble 2. Very stable under ordinary conditions	Wheat germ oil, green leaves and the embryos of seeds, carrots, cauliflower, lettuce, cucumber green pepper, raw potatoes, spinach, green peas, turnips, bananas, milk, butter

APPENDIX E

SELECTED BIBLIOGRAPHY

1 On Rice

Price
Rs. As.

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4. Effect of Milling on the Chemical Composition and Commercial Qualities of Raw and Parboiled Rice by V. Subrahmanyan, A. Sreenivasan and P. Das Gupta, Studies on quality in Rice. I

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1. Food by Robert Mc Carrison, 1936 Macmillan & Co., Limited, Bombay 0-12

2. The Nutritive Value of Indian Foods and the Planning of Satisfactory Diets (Revised and enlarged), Health Bulletin No. 23, 1938

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5. Some Defects in the National Diet of India and How to Remedy them Economically.
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Rs. As.

6. Ordinary Foods by J. C. Basak, 363, Upper Chitpore Road, Calcutta
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9. Your Diet in Health and Disease by Henry Benjamin, Published by Jethabhai Amarshi Shah, Harijan Ashram, Sabarmati 0- 12
10. Milk The Most Perfect Food by N N. Godbole, Benares Hindu University

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AND

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Packing		1	0	0
	Total	13	0	0
Dhenki parts				
Mortar and pestle		9	0	0
Models Dhenki		1	8	0
„ Paddy Chakki		1	8	0

The paddy chakki is made of wood. A woman working at it can prepare unpolished rice out of two maunds of paddy in a day of 8 hours. The grooves need to be renewed after husking about 12 to 15 maunds of paddy.

The dhenki is used for polishing rice. One person can polish in a day of 8 hours unpolished rice produced from four maunds of paddy. The mortar of the dhenki is so constructed that the rice circulates in a fixed direction automatically within it, thus eliminating the need for a person to sit by the mortar and stirring. The dhenki is, therefore, worked by one person only.

Rice:—A book regarding the food value of rice, instruments for rice pounding, and the economics of the rice-pounding industry, Detailed instructions for the manufacture of Paddy-husking Chakkis are also given therein.

Flour-Grinding

		Rs.	A.	P.
Complete chakki		30	0	0
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	Total	32	8	0
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Packing and cartage		1	0	0
	Total	18	0	0
Chakki platform		15	0	0
Packing		2	0	0
	Total	17	0	0
Adjustable parts Axle. Mani		0	8	0
Nut bolt		0	8	0
Packing		0	8	0
	Total	1	8	0
Model		1	8	0
Packing		0	8	0
	Total	2	0	0

The flour chakki is based on the Gujarat model with a few modifications. It rests on a wooden platform on which flour collects thus ensuring the cleanliness of the flour produced.

(1) A piece of bamboo is inserted over the iron handle to form a handle cover. This cover prevents the hand from chafing against the iron handle.

(2) The chakki has a device to raise or lower the upper stone for grinding coarse or fine as desired. This device is made with the help of nut bolts.

(3) One person can grind about 4 to 5 pounds of wheat on this chakki in an hour. Stones of good quality from Agra are used.

"Grinding of Cereals"

A book regarding home grinding of cereals and the instruments used in different parts with illustrations.
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Gandhiji says :—

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3 INDUSTRIES

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" 3rd Edition "	(H)	1-8-0	0-3-0
Magan Dipa (in press) 2nd Edition	(E) (H)		
Dhotijama	(H)	0-2-0	0-2-0

(Out of one Dhoti two garments—"Dhotijamas"—can be made thus halving the cost. This pamphlet describes how it is made.)

4. SURVEY

*** C. P. Government Industrial Survey Committee Reports**

(Under the Chairmanship of J. C. Kumarappa)

Gandhiji writes :—

"Chapter 2 dealing with general considerations stamps the report as an original document and shows that it is not to be pigeon-holed as most such reports are, but should be given effect to without delay."

"The committee has made practical suggestions on all the industries. The curious must procure the report and study it."

Part I. Vol 1. pp. 50			
General recommendations to Government based on a survey of 606 villages.	(E)	0-8-0	0-3-0
Part I, Vol 2, pp. 132			
Two selected District Survey Reports and Notes on 24 Village Industries	(E)	1-0-0	0-4-0
Part II, Vol 1 pp. 40			
Recommendations in regard to Forest, Mineral and Power Resources	(E)	0-8-0	0-3-0
Part II, Vol 2 pp. 109			
Selected portions of reports on Forests, Mineral and Power resources, and on Transport, Taxation and Marketing.	(E)	0-12-0	0-4-0
*** A Plan for the Economic Development of the N. W. F. Province, pp. 36** (with supplement) *By J. C. Kumarappa*	(E)	0-13-0	0-3-0

Sir Mirza Ismail writes :—"I should like to compliment you on the very lucid manner in which you have dealt with the various questions relating to the industrial development of the Province. You have approached the whole problem in a direct matter-of-fact and eminently practical way".

*** Survey of Matar Taluka** *By J. C. Kumarappa*	(E)	2-0-0	0-6-0

Kaka Saheb Kalelkar writes :—"The report is presented to the public as an authoritative document on the economic condition of a typical taluka of Gujarat. The reader will find

that the statistics presented here in careful schedules are even more eloquent than the main body of the carefully worded and lucid report itself. It is a vivid picture of the slow process of exploitation, emasculation and perhaps decimating of a patient and peaceful population ".

A Questionnaire for Rural Survey	(H) (E)	0-4-0	0-1-0
A Questionnaire for the Survey of Village Industries	(E)	1-8-0	0-4-0

5 SUNDRIES

A Guide to Maganvadi		(E)	0-3-0	0-1-0
" "		(H)	0-0-6	0-1-0
Views of Maganvadi	(28 pictures)	(E, H)	0-8-0	0-1-0

6 MISCELLANEOUS

*** Public Finance and Our Poverty**

By J. C. Kumarappa

3rd Edition

with a foreword by Gandhiji (E) 1-8-0 2-0-0

(in press) (H)

Gandhiji says:-

" The reader should carefully study these chapters which contain facts rather than arguments."

" I recommend the booklet both to the Indian as also to the Western readers."

The "Hindu" says :—

"The outspokenness of the analysis of the Indian problem is reinforced by revealing statistics in the book. The book deserves to be read by every student of Indian Economics."

*** Practice & Precepts of Jesus** (E) 1-8-0 0-2-0

By J. C. Kumarappa

Gandhiji says:—

"Having carefully gone through these chapters, I can recommend their perusal to every believer in God, be he a Christian or a follower of any other religion.........It is a revolutionary view of Jesus as a man of God......If all believe, as Prof. Kumarappa does, there will be no religious feuds and rivalries between sects and sects and different religions."

The Missionary Journal "Dnyanodaya" says:—

"We trust our readers will not fail to pray that the spirit of Christ, who led Prof: Kumarappa to write it, will bless its many reades......to read it is a searching spiritual exercise... The shining sincerity reflected on every page of this book makes it a benediction to read.

* **Christianity—**

Its Economy and Way of Life (E) 1-8-0 0-2-0

By J. C. Kumarappa

This is a critical examination of the economic order of the West in the light of the principles enunciated by Jesus.

Organisation and Accounts of Relief Work

By J. C. Kumarappa 1-0-0 0-2-0

Dr. Rajendra Prasad says:—

"This pamphlet summarises and collects and collates our experience and method of work [in Bihar Earthquake Relief] and Sri J. C. Kumarappa has done a public service in bringing together the points which may appear obvious now, but which were not so obvious when we started, and which needed much thought to make them clear. I hope it will prove help ful not only to new organizations engaged in similar work but also to students and would be organizers and social workers.

* **Clive to Keynes**

By J. C. Kumarappa (E) 0-12-0 0-1-0

(A survey of the history of our Public Debts and Sterling Securities)

The "Hindustan Times" says :—

"The brochure is packed with information which will have to be borne in mind when it comes to final reckoning with Britain."

Sterling Securities (E) (H) 0-4-0 0 1-0

By J C. Kumarappa

* **Stone Walls & Iron Bars** (E) [illegible] 0-2-0

By J.C.Kumarappa

(Gives an account of the jail experiences of the writer and his suggestions of reform).